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Energy Research Abstracts

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Office of Scientific and Technical Information
UNITED STATES DEPARTMENT OF ENERGY

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UNITED STATES DEPARTMENT OF ENERGY
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Energy Research Abstracts

Coverage

Energy Research Abstracts (ERA) provides abstracting and indexing coverage of all scientific and technical reports and patent applications originated by the U.S. Department of Energy, its laboratories, energy centers, and contractors, as well as theses and conference papers and proceedings issued by these organizations in report form. Audiovisual materials, computer media (magnetic tapes, diskettes, etc.), and engineering drawings are included in this definition. *ERA* also covers other energy information prepared *in report form* by federal and state government organizations, foreign governments, and domestic and foreign universities and research organizations, *provided* that the full text of the document has been received by OSTI. Foreign report information is obtained through the International Energy Agency's 14-nation Energy Technology Data Exchange, the International Atomic Energy Agency's International Nuclear Information System, or nation-to-nation agreements. The purpose of this publication is to announce documents produced or obtained by DOE that are not so readily available as journal articles, books, or patents.

Scope

The scope of *ERA* encompasses DOE's research, development, demonstration, and technology programs resulting from its broad charter for energy sources, supplies, safety, environmental impacts, and regulation.

The citations presented in *ERA* are available for online searching as records within the Energy Science and Technology Database (EDB). The current-year records are available on the Integrated Technical Information System (ITIS).

Availability

DOE and DOE contractors who have OSTI deposit accounts can obtain *ERA* (regular issues and annual indexes) from the Office of Scientific and Technical Information, P.O. Box 62, Oak Ridge, TN 37831, Attention: Information Services. For further information, call (615)576-8401. *ERA* is also available at authorized GPO Depository Libraries. (List is provided on the inside back cover.)

ERA (regular issues and annual indexes) is available to the public on a subscription basis from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

Managing Editor, Doris M. Henline
Technical Editor, Milton O. Whitson

Information Sources

The citations presented in *Energy Research Abstracts* are a subset of the worldwide energy information provided to the Office of Scientific and Technical Information (OSTI) through exchange agreements with foreign sources and through exchanges or contracts with U.S. organizations.

The **Energy Technology Data Exchange (ETDE)** was established by the International Energy Agency to promote cooperation among members in conducting appropriate energy-related research and development programs through the development of a formal central information sharing system. In accomplishing the objectives of the ETDE, members select, abstract, and index relevant research information published in their countries in accordance with Exchange standards. OSTI serves as the central receiving and processing center for this information, which it then disseminates to national centers in the participating countries. The following countries are currently members of the ETDE:

- Canada
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- Finland
- France
- Federal Republic of Germany
- Italy
- Japan
- The Netherlands
- Norway
- Spain
- Sweden
- Switzerland
- United Kingdom
- United States

The **International Nuclear Information System (INIS)** was established to promote the exchange of information on nuclear science and technology. Its operation is similar to that of the ETDE, with the INIS Secretariat being located in Vienna, Austria. Currently, 79 countries and 15 international organizations are members of INIS. OSTI serves as the INIS national center for the United States.

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The principal data elements included in these citations are:

1. **Abstract number** within volume.
2. **Report number** identification for report-type literature.
3. **Title and subtitle** (non-English title may appear in parentheses, if applicable).
4. **Author(s).** First 10 names in the data record are printed, then "et al." is listed.
5. **Author affiliation.** Only first one is listed, in parentheses after author(s) to which it applies.
6. **Collaboration,** if present.
7. **Corporate author(s)** identifying corporation responsible for document.
8. **Date of publication.** If not known, a processing date is in brackets.
9. **Number of pages** or page range. Prices are based on total pages unless special pricing applies.
10. **Language** of document if non-English.
11. **Monograph title** if citation is an analytic (part, chapter, or paper) of a larger monograph.
12. **Sponsoring organization.**
13. **Contract or grant number.**
14. **Secondary identifying number;** may be a conference number.
15. **Conference title, location, and date,** if applicable.
16. **Order number.** The "DE" order number may be used for ordering from NTIS or OSTI, as appropriate. The "TI" prefix is valid only at OSTI.
17. **Sources of availability** from which a copy of the document may be obtained; usually appear as abbreviations. (See information on following page.)
18. **Drop note** or explanatory statement.
19. **Abstract.**
20. **Subject descriptors.** Listed only if no abstract or only a brief statement is included.

Sample Citations

Report

18494 (DOE/ER/40438–T1) **[Development of a hydrogen and deuterium polarized gas target for application in storage rings]: Progress report.** Haeberli, W. Phys. VI collaboration. Wisconsin Univ., Madison (USA). Dept. of Physics. [1989]. 12p. Sponsored by DOE Energy Research. DOE Contract FG02-88ER40438. Order Number DE89007246. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This paper briefly discusses the Wisconsin test facility for storage cells; results of target tests; the new UHV...

Report Analytic

18500 (INIS-SU—69, pp. 30-32) **Transition energies in Ne-like ions. Correlation effects.** Vainshtejn, L.A. AN SSSR, Moscow. Fizicheskij Inst. 1988. (In Russian). In *Experimental and theoretical physics. Collection.* Order Number DE89780060. Available from NTIS (US Sales Only), PC A03/MF A01; INIS.

Kratkie Soobshcheniya po Fizike.; no. 6.

SILVER IONS/energy-level transitions; XENON IONS/energy-level transitions; CORRELATIONS; D STATES; E STATES;...

54 (DOE/ER/60888-1-Vol.1, pp. 115-117) **Investigation of air pollution in house due to use of various fuels.** Luo, Dayu (Chengdu Sanitation (China)). Canada Mortgage and Housing Corp., Ottawa, ON (Canada). 1990. (CONF-900724-Vol.1: Indoor Air '90: 5th international conference on indoor air quality and climate, Toronto (Canada), 29 Jul - 3 aug 1990). In Indoor air '90: The fifth international conference on indoor air quality and climate. Volume 1: Final report. 786p. Order Number DE90017786. Source: NTIS.

Air pollution in houses caused by combustion of coal is more serious than that by combustion of natural gas and methane (primarily by SO_2 and NO_2). The gas concentration after cooking is higher than that before cooking, and it is higher in kitchen than in bedroom and outdoor. There were mutations in the extract from TSP in $30m^2$ air in the bedroom, kitchen and outdoor, where coal and natural gas were used. The supernatant saliva activity of children whose family uses coal is significantly lower than that of pumping streams.

How To Order from the Availability Sources

TO OBTAIN A REPORT

Report literature, usually identified by an alphanumeric identifier at the beginning of a citation, is available from the sources listed in the citation (see example of element 2 on page iii). Often the sources are listed as abbreviations. Corresponding addresses are provided at right from which documents with these abbreviations may be ordered. When "OSTI" is given, **DOE and DOE contractors may order these documents from OSTI.** (However, check with your library or information organization which may require that orders go through them to OSTI.) OSTI prices are based on total pages unless special pricing applies. The public should order from NTIS or from one of the other agencies listed in the citation. NTIS price codes may continue to appear in some records. To expedite processing, an order form is provided in the back of this publication. NOTE: The order numbers provide quicker access for report ordering. Use the order number where possible.

GPO	Superintendent of Documents Government Printing Office Washington, DC 20402
GPO Dep.	Available for inspection or interlibrary loan at Government Printing Office regional depository libraries.
INIS	*Available only in microfiche.* INIS Clearinghouse International Atomic Energy Agency P.O. Box 100, A-1400 Vienna, Austria
NTIS	U.S. Department of Commerce National Technical Information Service 5285 Port Royal Road Springfield, VA 22161
OSTI	U.S. Department of Energy Office of Scientific and Technical Information P.O. Box 62 Oak Ridge, TN 37831
ESTSC	Energy Science and Technology Software Center P.O. Box 1020 Oak Ridge, TN 37831-1020

How To Use the Indexes

Five indexes are provided for approaching the content of each issue of *Energy Research Abstracts.* Descriptions of entries in these indexes follow.

Corporate Author Index
The corporation, organization, or institution responsible for the issuance of the document is listed in this index. The entries are arranged alphabetically and provide the title and citation number of the reference. For example, the listing for the "Report" sample citation would appear as shown at right.

Wisconsin Univ., Madison (USA). Dept. of Physics
[Development of a hydrogen and deuterium polarized gas target for application in storage rings]: Progress report, 15:18494 (R;US)
Wisconsin Univ., Madison (USA). Lab. of Genetics
Organization of the R chromosome region in maize: Final progress report, June 1, 1983–May 31, 1986, 15:18255 (R;US)

Personal Author Index
Each author's name listed on a document cited in this issue is indexed. An index entry provides title and citation number; for secondary and other names, a cross-reference is given to the primary author name where the full index entry is located.

Hadley, D.L., *See* Lee, A.D., 15:17651
Haeberli, W., [Development of a hydrogen and deuterium polarized gas target for application in storage rings]: Progress report, 15:18494 (R;US)

Subject Index
This index lists the main subject descriptors assigned to each record by indexing professionals. A secondary or qualifier term is used where necessary to describe materials, objects, and processes. Document titles may be enhanced with additional informative phrases where necessary. An excerpt from this index appears at right.

HYDROGEN ISOTOPES
See also DEUTERIUM
HYDROGEN 4
TRITIUM
Neutron-Rich Isotopes
Study on the strong neutron-rich nuclei of lightest elements, 15:18686 (RA;SU;In Russian)

Contract Number Index
DOE technical reports are listed by contract number. Each entry also provides the primary corporation or organization cited for that contract number. A typical entry is shown.

FG02-88ER40438 **Wisconsin Univ., Madison (USA). Dept. of Physics**
15:18494 DOE/ER/40438–T1
FG02-88ER60664 **Rogers and Associates Engineering Corp., Salt Lake City, UT (USA)**

Report Number Index
Technical report literature is indexed by the alphanumerical identifier of the report. Patent documents and conferences are included for convenience. Each entry lists the citation number, the source of availability of the document, an indicator of presence at a GPO depository library, order number, and distribution category. A typical entry is:

DOE/ER/40438–T1	15:18494	NTIS, OSTI	E 1.99: DE89007246	MF-411

Subject Contents

The subject content of *Energy Research Abstracts* is arranged as shown below. The two-digit and four-digit category numbers printed here illustrate the category number assignment used in the database records.* The following list includes all of the 38 first-level and the 313 second-level categories. Because each issue of *ERA* publishes citations only for those documents announced during the past semimonthly period, some subject categories may not be present in every issue.

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*The numerical subject category scheme is used in the storage, retrieval, and manipulation of bibliographic information entered into DOE's data systems. Categories and definitions for the complete set of six-digit numbers are given in ETDE/PUB--1-R2, *International Energy: Subject Categories and Scope*.

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Energy Research Abstracts

01 COAL, LIGNITE, AND PEAT

0103 Preparation

Refer also to citation(s) 25567, 25570

25477 (DOE/PC/79890–T1) **Ultrasonic ash/pyrite liberation: Final technical report.** Yungman, B.A.; Buban, K.S.; Stotts, W.F. CoaLiquid, Inc., Louisville, KY (United States). Jun 1990. 72p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-87PC79890. Order Number DE93013529. Source: OSTI; NTIS; GPO Dep.

The objective of this project was to develop a coal preparation concept which employed ultrasonics to precondition coal prior to conventional or advanced physical beneficiation processes such that ash and pyrite separation were enhanced with improved combustible recovery. Research activities involved a series of experiments that subjected three different test coals, Illinois No. 6, Pittsburgh No. 8, and Upper Freeport, ground to three different size fractions (28 mesh x 0, 200 mesh x 0, and 325 mesh x 0), to a fixed (20 kHz) frequency ultrasonic signal prior to processing by conventional and microbubble flotation. The samples were also processed by conventional and microbubble flotation without ultrasonic pretreatment to establish baseline conditions. Product ash, sulfur and combustible recovery data were determined for both beneficiation processes.

0104 Processing

Refer also to citation(s) 25569, 25579, 25925, 25943, 26093, 26094, 26095, 26096, 26097, 26098, 26099, 26100, 26101, 26102, 26105, 26106, 26107

25478 (CONF-890902–30) **Use of dispersed catalysts for coal liquefaction.** Hirschon, A.S.; Wilson, R.B. Jr. SRI International, Menlo Park, CA (United States). [1989]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-87PC79936 ;FG22-85PC80906. From 198. national meeting of the American Chemical Society (ACS); Miami, FL (United States); 10-15 Sep 1989. Order Number DE93012938. Source: OSTI; NTIS; GPO Dep.

We have briefly explored the use of dispersed catalysts for conversion of an Illinois No. 6 coal into soluble products. We compared both supported and non-supported catalysts and found that the non-supported catalysts gives superior conversions. The non-supported catalysts were impregnated into the coal by use of either aqueous metal salts or organic solutions of organometallic complexes. The organometallic precursors were found to be exceptionally active and provide the greatest yields of toluene soluble products. Our key to effective dispersed catalysts is the use of a soluble sulfido complex that does not require high temperature activation.

25479 (DOE/ER/13616–7) **Coal liquefaction model compounds: Progress report.** Gajewski, J.J.; Gilbert, K.E. Indiana Univ., Bloomington, IN (United States). [1992]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-86ER13616. Order Number DE93017057. Source: OSTI; NTIS; GPO Dep.

This progress report is divided into sections dealing with tetralin pyrolysis, chroman pyrolysis, solvent effects on reactions, pi conjugated biradical, and molecular mechanics of organometallic systems. Proposals are given as well as current progress.

25480 (DOE/MC/24267–3330) **Development of an advanced, continuous mild gasification process for the production of co-products technical evaluation: Final report.** Ness, R.O. Jr.; Runge, B.; Sharp, L. North Dakota Univ., Grand Forks, ND (United States). Energy and Environmental Research Center. Nov 1992. 247p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC21-87MC24267. Order Number DE93000267. Source: OSTI; NTIS; GPO Dep.

The University of North Dakota Energy and Environmental Research Center (EERC) and the AMAX Research and Development Center are cooperating in the development of a Mild Gasification process that will rapidly devolatilize coals of all ranks at relatively low temperatures between 930° and 1470°F (500°and 800°C) and near atmospheric pressure to produce primary products that include a reactive char, a hydrocarbon condensate, and a low-Btu gas. These will be upgraded in a "coal refinery" system having the flexibility to optimize products based on market demand. Task 2 of the four-task development sequence primarily covered bench-scale testing on a 10-gram thermogravimetric analyzer (TGA) and a 1 to 4-lb/hr continuous fluidized-bed reactor (CFBR). Tests were performed to determine product yields and qualities for the two major test coals-one a high-sulfur bituminous coal from the Illinois Basin (Indiana No. 3) and the other a low-sulfur subbituminous coal from the Powder River Basin (Wyodak). Results from Task 3, on product upgrading tests performed by AMAX Research and Development (R&D), are also reported. Task 4 included the construction, operation of a Process Research Unit (PRU), and the upgrading of the products. An economic evaluation of a commercial facility was made, based on the data produced in the PRU, CFBR, and the physical cleaning steps.

25481 (DOE/MC/24267–3331) **Development of advanced, continuous mild gasification process for the production of co-products addendum to technical evaluation: Final report.** North Dakota Univ., Grand Forks, ND (United States). Energy and Environmental Research Center. Nov 1992. 149p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC21-87MC24267. Order Number DE93000268. Source: OSTI; NTIS; GPO Dep.

This report contains the material balance data for Wyodak, Indiana No. 3, and Cannelton coals that were tested in the mild gasification program. Data include tests conducted using the 1- to 4-lb/hr continuous fluid-bed reactor (CFBR) and the 100-lb/hr Process Research Unit (PRU). All raw analysis data were reduced to calculate product yields as a percentage of the product mass divided by the maf coal feed. The material closure was then determined, and losses were assigned to one or a combination of the three product streams: char, condensate (includes condensed steam), and gas. Mass was added proportionally to each constituent of the stream until the closure was 100%.

25482 (DOE/METC–92/6128-Vol.1, pp. 111-114) **Catalytic gasification fundamentals.** Heinemann, H. (Lawrence Berkeley Laboratory, CA (US)); Somorjai, G.A. USDOE Morgantown Energy Technology Center, WV (United States). Sep 1992. DOE Contract AC03-76SF00098. (CONF-920951–Vol.1: 12. annual gasification and gas stream cleanup systems contractors review meeting, Morgantown, WV (United States), 15-17 Sep 1992). In *Proceedings of the twelfth annual gasification and gas stream cleanup systems contractors review meeting: Volume 1.* 325p. Order Number DE93000228. Source: OSTI; NTIS.

The major purpose of this project is to find catalysts which will permit steam gasification of carbonaceous materials at reasonable rates and at lower temperatures than currently practiced. Rapid catalyst deactivation must be avoided. An understanding of the catalytic mechanism is necessary to provide leads toward this aim.

25483 (DOE/METC–92/6128-Vol.1, pp. 115-118) **Production of mild gasification coproducts.** Horne, D.A. (SGI Fuels, Inc., La Jolla, CA (US)). USDOE Morgantown Energy Technology Center, WV (United States). Sep 1992. DOE Contract AC21-91MC27240. (CONF-920951–Vol.1: 12. annual gasification and gas stream cleanup systems contractors review meeting, Morgantown, WV (United States), 15-17 Sep 1992). In *Proceedings of the twelfth annual gasification and gas stream cleanup systems contractors*

review meeting: Volume 1. 325p. Order Number DE93000228. Source: OSTI; NTIS.

SGI will produce and deliver coproduct samples of the Liquid From Coal (LFC) process from specific coals. The coproduct liquid and solid samples will be delivered to METC designated laboratories for test and characterization. Characterization information will be returned to SGI and incorporated in the final report of the project.

25484 (DOE/METC–92/6128-Vol.1, pp. 134-142) **H_2S-removal and sulfur-recovery processes using metal salts.** Lynn, S. (Lawrence Berkeley Laboratory, CA (US)). USDOE Morgantown Energy Technology Center, WV (United States). Sep 1992. (CONF-920951–Vol.1: 12. annual gasification and gas stream cleanup systems contractors review meeting, Morgantown, WV (United States), 15-17 Sep 1992). In *Proceedings of the twelfth annual gasification and gas stream cleanup systems contractors review meeting: Volume 1.* 325p. Order Number DE93000228. Source: OSTI; NTIS.

This project is exploring the technical and economic feasibility of using two medium- to high-temperature processes for cleaning coal gas prior to combustion in a gas turbine used for power production. A zero-emissions process for converting a mixture of hydrogen sulfide and carbon dioxide to sulfur and synthesis gas is also under study. In the medium-temperature process, coal gas is scrubbed with a solution of copper sulfate, which forms the insoluble sulfide and removes hydrogen sulfide from the high-pressure gas at its adiabatic saturation temperature. CuS would be oxidized with ferric ion to regenerate the original sulfate and for elemental sulfur. In the high-temperature process the coal gas would pass through a nearly-isothermal, moving bed of calcium carbonate that would serve to remove particulates (by filtration), hydrogen chloride and hydrogen sulfide (by chemisorption), and ammonia (by catalysis). The objective of this research is to define the temperature at which these goals can be realized at a given pressure. Preliminary calculations indicate a probable range for the temperature of 650° to 900°C, about 100° to 400° below the outlet temperature of most gasifiers. In the course of experiments on the sorption of hydrogen sulfide from gases containing carbon dioxide it was discovered that a reaction producing elemental sulfur occurs. The reaction products also include carbon monoxide and hydrogen. Sulfur formation is favored by high temperature, low pressure and a high CO_2/H_2S ratio. Since unreacted CO_2 and H_2S could be recycled and there would be no tail-gas stream, a process based on this chemistry could lead to an emissions-free alternative to conventional Claus technology. A study is currently underway to determine the kinetics of the key reaction steps and to evaluate the process economics.

25485 (DOE/METC–92/6128-Vol.1, pp. 143-153) **Production of hydrogen and coproducts from coal.** Hauserman, W.B. (Univ. of North Dakota, Grand Forks (US)). USDOE Morgantown Energy Technology Center, WV (United States). Sep 1992. (CONF-920951–Vol.1: 12. annual gasification and gas stream cleanup systems contractors review meeting, Morgantown, WV (United States), 15-17 Sep 1992). In *Proceedings of the twelfth annual gasification and gas stream cleanup systems contractors review meeting: Volume 1.* 325p. Order Number DE93000228. Source: OSTI; NTIS.

The purpose of this program at the Energy and Environmental Research Center (EERC) is to explore catalytic effects of various salts and minerals on the reaction rates and product yields during coal gasification, primarily with respect to hydrogen and methane, for potential fuel cell use. The ultimate objectives are to identify the most effective and economic additives to maximize reaction rates, thus minimizing the required capital investment per throughput capacity.

25486 (DOE/METC–92/6128-Vol.1, pp. 165-173) **Coal ash behavior in reducing environments.** Erickson, T.A. (Univ. of North Dakota, Grand Forks (US)); Steadman, E.N.; Brekke, D.W.; Folkedahl, B.C.; Tibbetts, J.E.; Nowok, J. USDOE Morgantown Energy Technology Center, WV (United States). Sep 1992. (CONF-920951–Vol.1: 12. annual gasification and gas stream cleanup systems contractors review meeting, Morgantown, WV (United States), 15-17 Sep 1992). In *Proceedings of the twelfth annual gasification and gas stream cleanup systems contractors review meeting: Volume 1.* 325p. Order Number DE93000228. Source: OSTI; NTIS.

The objective of the Coal Ash Behavior in Reducing Environments (CABRE) program is to advance the knowledge of ash behavior in coal gasification systems; this knowledge will help provide the tools needed to operate advanced coal utilization systems efficiently with a minimum of operational problems associated with ash properties. The program approach is to use carefully controlled, laboratory-scale gasification experiments coupled with detailed analysis of the materials involved to determine the critical fundamental mechanisms of ash behavior in coal gasification systems.

25487 (DOE/METC–92/6128-Vol.1, pp. 189-194) **Selection of non-absorbing alkali components.** Lee, S.H.D. (Argonne National Laboratory, IL (US)); Natesan, K.; Swift, W. USDOE Morgantown Energy Technology Center, WV (United States). Sep 1992. (CONF-920951–Vol.1: 12. annual gasification and gas stream cleanup systems contractors review meeting, Morgantown, WV (United States), 15-17 Sep 1992). In *Proceedings of the twelfth annual gasification and gas stream cleanup systems contractors review meeting: Volume 1.* 325p. Order Number DE93000228. Source: OSTI; NTIS.

The principal objective of this work is to identify metallic material(s) that will not adsorb alkali vapors for use in alkali sampling lines and/or process component materials for advanced coal utilization systems. Also being sought are a better understanding of the alkali adsorption mechanism of metallic materials and their behavior under combustion off-gas and gasification fuel gas environments.

25488 (DOE/METC–92/6128-Vol.1, pp. 195-204) **Advanced lightweight ceramic candle filter module.** Zievers, J.F. (Industrial Filter & Pump Mfg. Co., Cicero, IL (US)). USDOE Morgantown Energy Technology Center, WV (United States). Sep 1992. (CONF-920951–Vol.1: 12. annual gasification and gas stream cleanup systems contractors review meeting, Morgantown, WV (United States), 15-17 Sep 1992). In *Proceedings of the twelfth annual gasification and gas stream cleanup systems contractors review meeting: Volume 1.* 325p. Order Number DE93000228. Source: OSTI; NTIS.

Vacuum formed aluminosilicate fiber has often been post-treated to add strength and density. At high operating temperatures it's material strength rivals that of costly alloys. Using relatively inexpensive materials, service operating temperatures of up to 2730°F (1500°C) can be realized. After wrestling with the engineering problems and the manufacturing costs of alloy tubesheets at elevated temperatures, Industrial Filter & Pump Mfg. Co. and Universal Porosics, Inc. reached an agreement for joint development of light weight, alternative (ceramic) structural materials. After several years, a family of products trademarked Fibro™, were developed from vacuum formed alumino silicate fibers. The basic formed pieces are post treated for additional strength and density. The finished raw product is then fire cured to produce the Fibro family of structural ceramics. A combination of these Fibro materials has been in operation for 18 months in a 4000 ACFM filter at temperatures of up to 1830°F (1000°C) to verify the suitability of an "all ceramic" hot gas filter system.

25489 (DOE/METC–92/6128-Vol.1, pp. 205-217) **Low-cost ceramic membranes and supports for gas separation.** Goldsmith, R.L. (CeraMem Corp., Waltham, MA (US)). USDOE Morgantown Energy Technology Center, WV (United States). Sep 1992. (CONF-920951–Vol.1: 12. annual gasification and gas stream cleanup systems contractors review meeting, Morgantown, WV (United States), 15-17 Sep 1992). In *Proceedings of the twelfth annual gasification and gas stream cleanup systems contractors review meeting: Volume 1.* 325p. Order Number DE93000228. Source: OSTI; NTIS.

The objectives of this program are to: (1) Develop a passive, highly selective, molecular sieve membrane capable of purifying coal process conversion gases at temperatures over 600°C. (2) Fabricate and determine the performance characteristics of such a membrane based on a practical (i.e., low cost, high surface area) support module.

25490 (DOE/METC–92/6128-Vol.1, pp. 221-229) **Bench-scale testing and evaluation of the direct sulfur recovery process.**

McMichael, W.J. (Research Triangle Institute, Research Triangle Park, NC (US)); Agarwal, S.K.; Chen, D.H.; Hopper, J.R. USDOE Morgantown Energy Technology Center, WV (United States). Sep 1992. (CONF-920951–Vol.1: 12. annual gasification and gas stream cleanup systems contractors review meeting, Morgantown, WV (United States), 15-17 Sep 1992). In *Proceedings of the twelfth annual gasification and gas stream cleanup systems contractors review meeting: Volume 1.* 325p. Order Number DE93000228. Source: OSTI; NTIS.

The objective of this work is to demonstrate on a bench-scale the Direct Sulfur Recovery Process (DSRP) for up to 99 percent or higher recovery of sulfur (as elemental sulfur) from regeneration off-gases and coal-gas produced in integrated gasification combined cycle (IGCC) power generating systems. Fundamental kinetic and thermodynamic studies will also be conducted to explain the mechanism of DSRP reactions. The goal of the project is to advance the DSRP technology to the point where industry is willing to support its further development.

25491 (DOE/METC–92/6128-Vol.1, pp. 230-239) **Enhanced durability of high-temperature desulfurization sorbents for moving-bed applications.** Ayala, R.E. (GE Corporate R&D, Schenectady, NY (US)); Gal, E.; Gupta, R.P. USDOE Morgantown Energy Technology Center, WV (United States). Sep 1992. (CONF-920951–Vol.1: 12. annual gasification and gas stream cleanup systems contractors review meeting, Morgantown, WV (United States), 15-17 Sep 1992). In *Proceedings of the twelfth annual gasification and gas stream cleanup systems contractors review meeting: Volume 1.* 325p. Order Number DE93000228. Source: OSTI; NTIS.

The objective of this project is to develop chemically reactive and mechanically durable zinc ferrite and zinc titanate sorbent formulations that are suitable for moving-bed, high-temperature, coal gas desulfurization processes. Zinc ferrite formulations were studied under the Base program; novel mixed-metal oxide formulations, particularly zinc titanates, are being studied in the current Option 2 program.

25492 (DOE/METC–92/6128-Vol.1, pp. 240-252) **Enhanced durability of desulfurization sorbents for fluidized-bed applications.** Gupta, R.P. (Research Triangle Institute, Research Triangle Park, NC (US)). USDOE Morgantown Energy Technology Center, WV (United States). Sep 1992. (CONF-920951–Vol.1: 12. annual gasification and gas stream cleanup systems contractors review meeting, Morgantown, WV (United States), 15-17 Sep 1992). In *Proceedings of the twelfth annual gasification and gas stream cleanup systems contractors review meeting: Volume 1.* 325p. Order Number DE93000228. Source: OSTI; NTIS.

The objectives of this project are to identify and demonstrate methods for enhancing long-term chemical reactivity and attrition resistance of zinc ferrite and zinc titanate sorbents to be employed for desulfurization of hot coal-derived gases in a high-temperature, high-pressure (HTUP) fluid-bed reactor. The sorbent formulation specified for study during the base period of this project was zinc ferrite. Zinc titanate sorbents are being studied under two options to the base contract. Specific objectives of the zinc titanate sorbent development work are the following.

25493 (DOE/METC–92/6128-Vol.1, pp. 253-262) **In situ real-time species analysis of particulates and deposits.** Ottesen, D.K. (Sandia National Labs., Livermore, CA (US)). USDOE Morgantown Energy Technology Center, WV (United States). Sep 1992. (CONF-920951–Vol.1: 12. annual gasification and gas stream cleanup systems contractors review meeting, Morgantown, WV (United States), 15-17 Sep 1992). In *Proceedings of the twelfth annual gasification and gas stream cleanup systems contractors review meeting: Volume 1.* 325p. Order Number DE93000228. Source: OSTI; NTIS.

This project is supported by the AR&TD Instrumentation and Diagnostics Program to develop optical diagnostic techniques for real-time in situ species analysis of both particles and surfaces in advanced coal-based power systems. The goal of this research is to apply these optical methods: (1) to the development and testing of ceramic materials for use as hot gas cleanup filters; and (2) as a real-time monitor for the composition of both gas and particles in clean, hot gas process streams.

25494 (DOE/METC–92/6128-Vol.1, pp. 263-279) **Sensitivity of hot gas desulfurization on IGCC cost of electricity.** Chen, H.T. (Gilbert/Commonwealth, Inc., Reading, PA (US)); Klett, M.G.; Rutkowski, M.D. USDOE Morgantown Energy Technology Center, WV (United States). Sep 1992. (CONF-920951–Vol.1: 12. annual gasification and gas stream cleanup systems contractors review meeting, Morgantown, WV (United States), 15-17 Sep 1992). In *Proceedings of the twelfth annual gasification and gas stream cleanup systems contractors review meeting: Volume 1.* 325p. Order Number DE93000228. Source: OSTI; NTIS.

The objectives of these studies were (1) to conduct economic sensitivity analyses to highlight the overall effect of varying sulfur control and sulfur by-product parameters on the cost of electricity, and (2) to conduct a preliminary assessment of the comparative technical and economic characteristics of the moving bed and fluid bed hot gas desulfurization processes.

25495 (DOE/METC–92/6128-Vol.1, pp. 280-288) **Standleg moving granular bed filter development program.** Yang, Wen-Ching (Westinghouse Electric Corporation Science & Technology Center, Pittsburg, PA (US)); Smeltzer, E.E. USDOE Morgantown Energy Technology Center, WV (United States). Sep 1992. DOE Contract AC21-91MC27259. (CONF-920951–Vol.1: 12. annual gasification and gas stream cleanup systems contractors review meeting, Morgantown, WV (United States), 15-17 Sep 1992). In *Proceedings of the twelfth annual gasification and gas stream cleanup systems contractors review meeting: Volume 1.* 325p. Order Number DE93000228. Source: OSTI; NTIS.

The objectives of the base contract are: To identify and define the barrier technical issues associated with the development of the Standleg Moving Granular Bed Filter (SMGBF). To devise a test plan to resolve the barrier technical issues. To design, procure, and install the component test facilities. To conduct tests in accordance to the test plan. To develop conceptual designs of the SMGBF system integrated into a commercial-scale PFBC and IGCC plants. To describe the results and to provide an assessment of the success of the program in resolving the barrier technical issues.

25496 (DOE/METC–92/6128-Vol.1, pp. 289-296) **Moving granular bed filter development program.** Haas, J.C. (Combustion Power Company, Menlo Park, CA (US)); Eshelman, M.B. USDOE Morgantown Energy Technology Center, WV (United States). Sep 1992. (CONF-920951–Vol.1: 12. annual gasification and gas stream cleanup systems contractors review meeting, Morgantown, WV (United States), 15-17 Sep 1992). In *Proceedings of the twelfth annual gasification and gas stream cleanup systems contractors review meeting: Volume 1.* 325p. Order Number DE93000228. Source: OSTI; NTIS.

Efforts to design and operate coal-fired gas turbines plants in advanced gasification and combustion power cycles have been intensified in recent years. These efforts, such as those carried out by Combustion Power Company in the early 1970's, have been plagued by turbine problems due to ash-ladened combustion gases. It is generally recognized that a hot gas cleanup train must be used before the gas turbine to remove the major portion of the particulate. Advantages are also evident for a filter system that can remove other coal derived contaminants such as sulfur and alkali. With most particulate and other contaminants removed, erosion and corrosion of turbine materials, as well as deposition of particles within the turbine, are reduced to acceptable levels.

25497 (DOE/METC–92/6128-Vol.1, pp. 297-314) **Thermal/chemical stability of ceramic cross flow filter materials.** Bachovchin, D.M. (Westinghouse Electric Corp. Science & Technology Center, Pittsburgh, PA (US)); Lippert, T.E.; Tressler, R.E.; McNerney, K.B. USDOE Morgantown Energy Technology Center, WV (United States). Sep 1992. (CONF-920951–Vol.1: 12. annual gasification and gas stream cleanup systems contractors review meeting, Morgantown, WV (United States), 15-17 Sep 1992). In *Proceedings of the twelfth annual gasification and gas stream cleanup systems contractors review meeting: Volume 1.* 325p. Order Number DE93000228. Source: OSTI; NTIS.

The objectives of this program are to identify the potential long-term thermal/chemical effects that advanced coal-based power

generating system environments have on the stability of the ceramic cross flow filter materials, as well as to assess the influence of these effects on filter operating performance and life.

25498 (DOE/METC–92/6128-Vol.1, pp. 315-325) **Ceramic filters for removal of particulates from hot gas streams.** Goldsmith, R.L. (CeraMem Corp., Waltham, MA (US)). USDOE Morgantown Energy Technology Center, WV (United States). Sep 1992. DOE Contract FG02-90ER80896. (CONF-920951–Vol.1: 12. annual gasification and gas stream cleanup systems contractors review meeting, Morgantown, WV (United States), 15-17 Sep 1992). In *Proceedings of the twelfth annual gasification and gas stream cleanup systems contractors review meeting: Volume 1.* 325p. Order Number DE93000228. Source: OSTI; NTIS.

The primary goal of this Phase II SBIR program is to demonstrate the performance of a new ceramic filter in removing particulate matter from hot gas streams produced in advanced coal conversion processes. The specific objectives are threefold: (1) Development of full size ceramic filters suitable for hot gas filtration; (2) Demonstration of ceramic filters in long term (ca. 1000 hrs) field trials; and (3) Development of full-scale hot gas filter system designs and costs.

25499 (DOE/METC–92/6128-Vol.2, pp. 329-337) **Development of an electrochemical hydrogen separator.** Abens, S. (Energy Research Corp., Danbury, CT (US)); Fruchtman, J.; Kush, A. USDOE Morgantown Energy Technology Center, WV (United States). Sep 1992. (CONF-920951–Vol.2: 12. annual gasification and gas stream cleanup systems contractors review meeting, Morgantown, WV (United States), 15-17 Sep 1992). In *Proceedings of the twelfth annual gasification and gas stream cleanup systems contractors review meeting: Volume 2.* 314p. Order Number DE93000229. Source: OSTI; NTIS.

The objective of this program is to develop an electrochemical hydrogen separation device for cost-effective hydrogen recovery from various dilute hydrogen streams. Potential applications include high purity hydrogen recovery from oxygen and air blown gasifiers, as well as hydrogen-lean streams such as a carbonate fuel cell anode exhaust. Other potential applications include recovery of hydrogen used to mitigate corrosion in boiling water reactors (BWRs). In the present program, the effect of design and operating parameters e.g. pressure, temperature, and H_2 recovery on EHS performance have been characterized in single subscale cells (25 cm^2 active area) and presented as a mathematical model. Full size (1000 cm^2) multi-cell-stack long term operation has also be demonstrated. Process conceptual design and economics for a potential application will be evaluated for the EHS and a competing technology.

25500 (DOE/METC–92/6128-Vol.2, pp. 338-345) **Hydrogen separation by ceramic membranes in coal gasification.** Gavalas, G.R. (California Institute of Technology, Pasadena (US)). USDOE Morgantown Energy Technology Center, WV (United States). Sep 1992. (CONF-920951–Vol.2: 12. annual gasification and gas stream cleanup systems contractors review meeting, Morgantown, WV (United States), 15-17 Sep 1992). In *Proceedings of the twelfth annual gasification and gas stream cleanup systems contractors review meeting: Volume 2.* 314p. Order Number DE93000229. Source: OSTI; NTIS.

The general objective of this project is to develop inorganic membranes for separation of hydrogen from coal gas at high temperatures. The project includes the following tasks: (i) membrane development by chemical vapor deposition of dense silica layers within the pores of support tubes, (ii) membrane characterization, (iii) tests of membrane stability to extended operation in contact with a simulated coal gas, (iv) development of a model for combined shift reaction and membrane hydrogen separation, and (v) comparative economic analysis of membrane-based hydrogen production and a conventional process of hydrogen production from coal.

25501 (DOE/METC–92/6128-Vol.2, pp. 351-361) **Gas separations using ceramic membranes.** Lin, C.L. (Aluminum Company of America, Pittsburgh, PA (US)); Flowers, D.L.; Wu, J.C.S.; Smith, G.W.; Liu, P.K.T. USDOE Morgantown Energy Technology Center, WV (United States). Sep 1992. (CONF-920951–Vol.2: 12. annual gasification and gas stream cleanup systems contractors review meeting, Morgantown, WV (United States), 15-17 Sep 1992). In *Proceedings of the twelfth annual gasification and gas stream cleanup systems contractors review meeting: Volume 2.* 314p. Order Number DE93000229. Source: OSTI; NTIS.

In recent years, the use of ceramic membranes for high temperature gas separations has been gaining considerable attention. The objectives of this research and development effort are: (1) Evaluation of existing state of the art ceramic membranes with particular emphasis on material stability, product optimization and gas separation efficiency. (2) Development of mathematical models to simulate gas separations for a range of conditions encountered in coal off-gas cleanup operations and verification of results with experimental permeation and separation measurements at high temperatures (greater than 500°C) and high pressures (greater than 10 atm) using existing membranes. (3) Modifications of ceramic membrane to optimize and/or improve overall separation performance, and (4) For the purpose of process development and economic analysis, the performance of optimized products will be quantified under the proposed coal processing environments.

25502 (DOE/METC–92/6128-Vol.2, pp. 362-371) **A calcium oxide sorbent process for bulk separation of carbon dioxide.** Harrison, D.P. (Louisiana State Univ., Baton Rouge (US)); Silaban, A.; Narcida, M.; Han, C. USDOE Morgantown Energy Technology Center, WV (United States). Sep 1992. (CONF-920951–Vol.2: 12. annual gasification and gas stream cleanup systems contractors review meeting, Morgantown, WV (United States), 15-17 Sep 1992). In *Proceedings of the twelfth annual gasification and gas stream cleanup systems contractors review meeting: Volume 2.* 314p. Order Number DE93000229. Source: OSTI; NTIS.

The overall project is divided into two phases. Phase I, now complete, investigated the technical feasibility of a regenerable calcium sorbent-based process for the high-temperature, high-pressure (HTHP) separation of CO_2 from coal-derived gas. A high-pressure electrobalance reactor and microgram quantities of sorbent were used in this phase of the study. Favorable results led to continuation of the project into Phase II where a laboratory-scale fixed-bed reactor involving gram quantities of sorbent and with capability for product gas analysis is being used. The possibility of the simultaneous occurrence of the water-gas shift reaction and CO_2 separation is of particular interest in Phase II. Simultaneous reactions create the possibility of a direct, one-step process for producing hydrogen from coal-derived gas.

25503 (DOE/METC–92/6128-Vol.2, pp. 372-378) **Development of hollow-fiber catalytic-membrane reactors for high-temperature gas cleanup.** Ma, Yi H. (Worcester Polytechnic Institute, MA (US)); Moser, W.R.; Pien, Shyhing M. USDOE Morgantown Energy Technology Center, WV (United States). Sep 1992. (CONF-920951–Vol.2: 12. annual gasification and gas stream cleanup systems contractors review meeting, Morgantown, WV (United States), 15-17 Sep 1992). In *Proceedings of the twelfth annual gasification and gas stream cleanup systems contractors review meeting: Volume 2.* 314p. Order Number DE93000229. Source: OSTI; NTIS.

The goal of the project is to develop catalytic membrane reactors for IGCC gas cleanup at high temperatures and pressures. The objectives of this research and development effort are: (i) characterization of raw fibers and investigation of their permeability and thermal behavior, (ii) introduction of catalytic compounds on the hollow fiber and their characterization, and (iii) evaluation of catalytic membrane reactors for their performance in facilitating the decomposition of hydrogen sulfide in pure component and gas mixture systems.

25504 (DOE/METC–92/6128-Vol.2, pp. 379-384) **Development of ceramic membrane reactors for high temperature gas cleanup.** Roberts, D.L. (SRI International, Menlo Park, CA (US)); Way, J.D. USDOE Morgantown Energy Technology Center, WV (United States). Sep 1992. (CONF-920951–Vol.2: 12. annual gasification and gas stream cleanup systems contractors review meeting, Morgantown, WV (United States), 15-17 Sep 1992). In *Proceedings of the twelfth annual gasification and gas stream cleanup systems contractors review meeting: Volume 2.* 314p. Order Number DE93000229. Source: OSTI; NTIS.

The objective of this project is to develop high-temperature, high-pressure catalytic ceramic membrane reactors and to demonstrate the feasibility of using these membrane reactors to control gaseous contaminants in Integrated Gasification Combined Cycle (IGCC) systems. These catalytic membrane reactors will decompose hydrogen sulfide (H_2S) and ammonia (NH_3) and separate the reaction products. The reactors will be designed to operate in the hostile process environment encountered in IGCC systems, including temperatures ranging from 1,000 to 2,000°F and pressures from 200 to 1,000 psia. The research involves novel catalytic materials, modification of commercially available inorganic membranes, and the making of laboratory membrane reactors from these catalysts and modified membranes.

25505 (DOE/METC–92/6128-Vol.2, pp. 395-408) **Mechanical analysis of a cross flow filter.** Alvin, M.A. (Westinghouse Electric Corp. Science & Technology Center, Pittsburgh, PA (US)); Attaar, M.H. USDOE Morgantown Energy Technology Center, WV (United States). Sep 1992. (CONF-920951–Vol.2: 12. annual gasification and gas stream cleanup systems contractors review meeting, Morgantown, WV (United States), 15-17 Sep 1992). In *Proceedings of the twelfth annual gasification and gas stream cleanup systems contractors review meeting: Volume 2.* 314p. Order Number DE93000229. Source: OSTI; NTIS.

The objectives of this program are to improve the reliability, uniformity, and mechanical integrity of the cross flow filter through improved design, manufacturing, and quality assurance. The goal is to provide a cross flow filter that will endure the mechanical and thermal loads and stresses imposed during installation, startup, and operation (including pulse cleaning) at high temperature and high pressure which are indicative of advanced fossil power generation applications. This program provides the technology base for the development of the cross flow filter element including material properties, and supports the implementation of these filters into pilot plant and field demonstration facilities.

25506 (DOE/METC–92/6128-Vol.2, pp. 346-350) **High-temperature membranes for gas separation and gas cleanup.** Edlund, D.J. (Bend Research, Inc., OR (US)). USDOE Morgantown Energy Technology Center, WV (United States). Sep 1992. (CONF-920951–Vol.2: 12. annual gasification and gas stream cleanup systems contractors review meeting, Morgantown, WV (United States), 15-17 Sep 1992). In *Proceedings of the twelfth annual gasification and gas stream cleanup systems contractors review meeting: Volume 2.* 314p. Order Number DE93000229. Source: OSTI; NTIS.

These two programs are directed at furthering the development of two metal-membrane-based processes for (1) economically producing pure hydrogen from the raw gasifier stream, and (2) cleanly and efficiently removing hydrogen sulfide from the hot gas stream. Both of these processes would be accomplished at 700°C to 800°C and are based on a novel hydrogen-permeable composite-metal membrane. Specific program objectives include (1) design, fabrication, and demonstration of pre-prototype membrane modules, (2) improving the membrane composition to increase the hydrogen flux, (3) evaluating membrane lifetime, and (4) conducting engineering and economic analyses of the processes.

25507 (DOE/METC–92/6128-Vol.2, pp. 385-392) **Facilitated transport ceramic membranes for high temperature gas cleanup.** Minford, E. (Air Products and Chemicals, Inc., Allentown, PA (US)); Quinn, R. USDOE Morgantown Energy Technology Center, WV (United States). Sep 1992. (CONF-920951–Vol.2: 12. annual gasification and gas stream cleanup systems contractors review meeting, Morgantown, WV (United States), 15-17 Sep 1992). In *Proceedings of the twelfth annual gasification and gas stream cleanup systems contractors review meeting: Volume 2.* 314p. Order Number DE93000229. Source: OSTI; NTIS.

The objective of this project is to demonstrate the feasibility of developing high temperature, high pressure, facilitated transport ceramic membranes to control gaseous contaminants in Integrated Gasification Combined Cycle (IGCC) power generation systems.

25508 (DOE/METC–92/6128-Vol.2, pp. 409-413) **Particulate technology issues.** Pontius, D.H. (Southern Research Institute, Birmingham, AL (US)); Bush, P.V. USDOE Morgantown Energy Technology Center, WV (United States). Sep 1992. (CONF-920951–Vol.2: 12. annual gasification and gas stream cleanup systems contractors review meeting, Morgantown, WV (United States), 15-17 Sep 1992). In *Proceedings of the twelfth annual gasification and gas stream cleanup systems contractors review meeting: Volume 2.* 314p. Order Number DE93000229. Source: OSTI; NTIS.

Advanced systems for power generation based on coal combustion or gasification will require effective particulate control both for protection of equipment in the gas stream and for compliance with environmental regulations. These new classes of systems will require efficient removal of particles from gas streams at high temperature and high pressure. Primary candidates for particulate control are various types of ceramic filter systems; however, the long-term effects of hot gases and fine particles on the structure and filtration effectiveness of potential filter materials require further study. Thermal gradients induced by pulse cleaning are also of concern. Long-term "patch tests" will be conducted on ceramic disks of the same materials used in the fabrication of ceramic candles and ceramic cross-flow filters. The primary issues to be addressed in these tests are the long-term physical, thermal, and chemical stability of the ceramic materials; long-term pressure drop and filtration characteristics of the ceramic filters; potential for irreversible blinding of filter elements; and long-term performance and reliability of auxiliary hardware, such as the tube sheet and pulse-cleaning systems. Each long-term patch test will require about 3 to 4 months of nearly continuous operation.

25509 (DOE/METC–92/6128-Vol.2, pp. 414-420) **The metered delivery of solids into pressure: A radically new machine concept.** Hay, A.G. (STAMET, Inc., Gardena, CA (US)). USDOE Morgantown Energy Technology Center, WV (United States). Sep 1992. (CONF-920951–Vol.2: 12. annual gasification and gas stream cleanup systems contractors review meeting, Morgantown, WV (United States), 15-17 Sep 1992). In *Proceedings of the twelfth annual gasification and gas stream cleanup systems contractors review meeting: Volume 2.* 314p. Order Number DE93000229. Source: OSTI; NTIS.

This paper is the second published report on the continuing successful elaboration and embodiment of an entirely new patented machine concept for the continuous movement and accurately metered delivery of all sorts of particulate solids, wet or dry, into environments of ambient or differential fluid or mechanical pressure. It includes the first disclosure of the successful continuous, direct delivery of US power plant coal into 26 psi of gas pressure, which is itself an important milestone in a project for the continuing development of the system for very high pressure metered injection of solids. We call the device a "Rock Pump". More formally, it is the Firth Solids Pump System, after the inventor. Due to time constraints, camera-ready diagrams were not available at the time of publication. These diagrams are available free of charge by contacting Stephen Beer, Morgantown Energy Technology Center, Morgantown, West Virginia, 26507-0880, (304) 291-4040.

25510 (DOE/METC–92/6128-Vol.2, pp. 421-430) **Ion-exchange membranes for bulk separation of acid gases.** Pellegrino, J.J. (National Institute of Standards and Technology, Boulder, CO (US)); Giarratano, P. USDOE Morgantown Energy Technology Center, WV (United States). Sep 1992. (CONF-920951–Vol.2: 12. annual gasification and gas stream cleanup systems contractors review meeting, Morgantown, WV (United States), 15-17 Sep 1992). In *Proceedings of the twelfth annual gasification and gas stream cleanup systems contractors review meeting: Volume 2.* 314p. Order Number DE93000229. Source: OSTI; NTIS.

The overall goal of this program is to investigate the use of ion exchange membranes in the removal of acid gases during processing of natural gas or during production of H_2 from synthesis gas. As part of this goal we are running a field test of candidate membranes on a natural gas stream to obtain extended performance data on acid gas transport. Additionally we are working on strategies for increasing the productivity and lifetime of these types of membranes. The specific objectives include: Evaluate candidate membranes, carriers, solvents, treatments and the effects of process conditions for separation of the acid gases CO_2 and H_2S

from H_2, CO and CH_4. Develop mathematical models to guide experimental work and for interpretation of results. Construct and operate an extended-use test facility to evaluate the long term stability and productivity of various membrane forms relative to acid gases. Develop thin film composite membranes as a possible route to higher productivity and lower cost membranes. Develop preliminary process design and economic analysis for the use of these membranes in gas cleanup.

25511 (DOE/METC–92/6128-Vol.2, pp. 431-437) **High temperature hydrogen sulfide removal.** Copeland, R.J. (TDA Research, Inc., Wheat Ridge, CO (US)). USDOE Morgantown Energy Technology Center, WV (United States). Sep 1992. (CONF-920951–Vol.2: 12. annual gasification and gas stream cleanup systems contractors review meeting, Morgantown, WV (United States), 15-17 Sep 1992). In *Proceedings of the twelfth annual gasification and gas stream cleanup systems contractors review meeting: Volume 2.* 314p. Order Number DE93000229. Source: OSTI; NTIS.

The objective of this Phase II Small Business Innovation Research (SBIR) contract is to develop and test a regenerable stannic oxide-based sorbent to remove H_2S from hot coal gases while producing sulfur as the only product. The detailed technical objectives in support of this are: (1) Develop mechanically strong and chemically inert support materials which will retain their properties through multiple absorption-regeneration cycles. (2) Develop mathematical models to predict the performance of large-scale systems from bench-scale results. (3) Test the durability of the best sorbent/support combinations. (4) Conduct a bench-scale proof of concept test with the best stannic-oxide sorbent.

25512 (DOE/METC–92/6128-Vol.2, pp. 438-447) **Comparative study of the reactions of metal oxides with H_2S and SO_2.** Sotirchos, S.V. (Univ. of Rochester, NY (US)). USDOE Morgantown Energy Technology Center, WV (United States). Sep 1992. (CONF-920951–Vol.2: 12. annual gasification and gas stream cleanup systems contractors review meeting, Morgantown, WV (United States), 15-17 Sep 1992). In *Proceedings of the twelfth annual gasification and gas stream cleanup systems contractors review meeting: Volume 2.* 314p. Order Number DE93000229. Source: OSTI; NTIS.

The primary objective of this project is the investigation of the effects of pore structure on the capacity of porous metal oxides for removal of gaseous-pollutants from flue gases of power plants (SO_2) and hot coal gas (primarily H_2S). Porous calcines obtained from natural precursors (limestones and dolomites) and sorbents based on oxides of zinc, iron, and/or copper will be used as model systems in our experimental studies, which will include reactivity evolution studies and pore structure characterization using a variety of methods. Our work will focus on oxides that can react (sufficiently fast) both with SO_2 and H_2S. We intend to appropriately exploit the differences of the sulfidation and sulfation reactions (for instance, different molar volumes of solid products) to elucidate the dependence of the sorptive capacity of a porous sorbent on its physical microstructure.

25513 (DOE/METC–92/6128-Vol.2, pp. 448-455) **METC integrated bench-scale gasification and hot gas cleanup studies.** Rockey, J.M. (Morgantown Energy Technology Center, WV (US)); Kanosky, J.P.; Rutten, J. USDOE Morgantown Energy Technology Center, WV (United States). Sep 1992. (CONF-920951–Vol.2: 12. annual gasification and gas stream cleanup systems contractors review meeting, Morgantown, WV (United States), 15-17 Sep 1992). In *Proceedings of the twelfth annual gasification and gas stream cleanup systems contractors review meeting: Volume 2.* 314p. Order Number DE93000229. Source: OSTI; NTIS.

Integrated Gasification Combined Cycle (IGCC) power generation systems are emerging as potentially clean and economical coal-based power generation systems of the future. A key component of the IGCC system that can boost power plant efficiency is hot particulate and sulfur removal prior to electric generation. The Morgantown Energy Technology Center (METC) has an integrated gasification hot gas cleanup facility to develop hot particulate removal and desulfurization processes for IGCC systems.

25514 (DOE/METC–92/6128-Vol.2, pp. 456-468) **TGA studies on supported sorbents at elevated pressures.** Gasper-Galvin, L.D. (Morgantown Energy Technology Center, WV (US)); Gupta, R.P. USDOE Morgantown Energy Technology Center, WV (United States). Sep 1992. (CONF-920951–Vol.2: 12. annual gasification and gas stream cleanup systems contractors review meeting, Morgantown, WV (United States), 15-17 Sep 1992). In *Proceedings of the twelfth annual gasification and gas stream cleanup systems contractors review meeting: Volume 2.* 314p. Order Number DE93000229. Source: OSTI; NTIS.

The objective of the supported sorbents research at the Morgantown Energy Technology Center (METC) is to develop a hot gas desulfurization sorbent which will have superior attrition resistance, higher temperature capability, and increased sulfidation/regeneration cycle life, as compared to bulk metal oxide sorbents such as zinc ferrite and zinc titanate. Previous investigations of zeolite-supported sorbents at METC have been conducted at 205 kPa (15 psig). The purpose of this study was to use thermogravimetric analysis (TGA) to obtain information on the performance of zeolite-supported sorbents at a pressure which is similar to that expected in a commercial integrated gasification combined cycle (IGCC) plant.

25515 (DOE/METC–92/6128-Vol.2, pp. 469-478) **TGA characterization of char reactivity.** Shadle, L.J. (Morgantown Energy Technology Center, WV (US)); Wang, Yau-Hsin C. USDOE Morgantown Energy Technology Center, WV (United States). Sep 1992. (CONF-920951–Vol.2: 12. annual gasification and gas stream cleanup systems contractors review meeting, Morgantown, WV (United States), 15-17 Sep 1992). In *Proceedings of the twelfth annual gasification and gas stream cleanup systems contractors review meeting: Volume 2.* 314p. Order Number DE93000229. Source: OSTI; NTIS.

This is a report on the status and progress of studies to characterize the reactivities of coal char. The current experimental program was initiated to develop an empirical relationship that could describe the dependence of coal devolatilization rates and yields on coal particle sizes between 100 to 1,000 micrometers as part of the mild gasification program, in order to aid the conceptual design of a bench-scale reactor. The conceptual design comprised a fast fluidized-bed pyrolyzer in which the product char was to be burned in a fluidized-bed surge tank combustor prior to the solids recycle. The combustion reactivity of chars was measured following the devolatilization measurements. As a result, the combustion reactivity of various chars were determined as a function of particle size. The findings of the combustion reactivity measurements of coal chars are described in this report. The direct dependencies of particle size, coal type, and char preparation/generation heating rate and temperature are presented for combustion reactivities of chars.

25516 (DOE/METC–92/6128-Vol.2, pp. 479-497) **Trace contaminants in fixed-bed gasifier gas.** Grindley, T. (Morgantown Energy Technology Center. WV (US)); Gardner, T.H. USDOE Morgantown Energy Technology Center, WV (United States). Sep 1992. (CONF-920951–Vol.2: 12. annual gasification and gas stream cleanup systems contractors review meeting, Morgantown, WV (United States), 15-17 Sep 1992). In *Proceedings of the twelfth annual gasification and gas stream cleanup systems contractors review meeting: Volume 2.* 314p. Order Number DE93000229. Source: OSTI; NTIS.

A high-temperature, fixed-bed zinc ferrite, sidestream desulfurization unit has been utilized to study the desulfurization of hot gas from the METC 42-inch diameter, fixed-bed gasifier. Early investigations in 1983 (Grindley 1984) were during gasifier runs 101 to 104 and were concerned primarily with establishing the performance of regenerable desulfurization sorbents. In 1986, the sidestream unit was again operated during gasifier runs 105 through 107 and more detailed gas stream characterization was obtained. The purpose of this paper is to present the results of gas stream analyses sampled at the outlet of the gasifier and the inlet and outlet of the desulfurizer. The analyses were achieved by filtering particles from the hot gas and condensing water and tars from the filtered and unfiltered gases. Particles, condensates, and gases

were analyzed for sulfurous and nitrogenous compounds, halogens, trace metals, and various ionic species. The purpose for obtaining a detailed gas stream characterization is to aid in the study and design of hot gas purification concepts.

25517 (DOE/METC–92/6128-Vol.2, pp. 498-501) **Sulfur capture mechanisms.** Siriwardane, R.V. (Morgantown Energy Technology Center, WV (US)); Poston, J.A.; Woodruff, S.D. USDOE Morgantown Energy Technology Center, WV (United States). Sep 1992. (CONF-920951–Vol.2: 12. annual gasification and gas stream cleanup systems contractors review meeting, Morgantown, WV (United States), 15-17 Sep 1992). In *Proceedings of the twelfth annual gasification and gas stream cleanup systems contractors review meeting: Volume 2.* 314p. Order Number DE93000229. Source: OSTI; NTIS.

The Morgantown Energy Technology Center is currently involved in developing high-temperature cleanup for the integrated gasification combined cycle process. Solid sorbents are being employed to remove sulfur-bearing gases. Therefore, it is important to know the reaction mechanisms and kinetics of the interactions of the sulfur-bearing gases with sorbent materials, and the changes in elemental composition during reactions in order to develop novel sorbents or to unprove existing sorbents. In our previous work, the mechanisms of the reactions of CaO with SO_2/O_2, zinc titanate with H_2S/CO and H_2, and elemental changes in zinc copper ferrite during heating were investigated. The CaO reaction proceeds via $CaSO_3$, an intermediate, while in the zinc titanate reaction, $ZnSO_4$ was formed as an intermediate. Migration of copper to the surface and presence of copper in the +1 state was observed in zinc copper ferrite at 823K. in the present work, the characterization of fresh, sulfided, and regenerated zinc titanate sorbents, and the mechanism of sulfate formation during regeneration of zinc sulfide were investigated. X-ray photoelectron spectroscopy (XPS), scanning electron microscopy/electron dispersive analysis (SEM/EDS), and Fourier transform infra-red spectroscopy (FTIR) were used to analyze intermediates and products during the reaction.

25518 (DOE/METC–92/6128-Vol.2, pp. 502-510) **Studies of in-situ calcium-based sorbents in advanced pressurized coal conversion systems.** Katta, S. (M.W. Kellogg Company, Houston, TX (US)); O'Donnell, J.J. USDOE Morgantown Energy Technology Center, WV (United States). Sep 1992. (CONF-920951–Vol.2: 12. annual gasification and gas stream cleanup systems contractors review meeting, Morgantown, WV (United States), 15-17 Sep 1992). In *Proceedings of the twelfth annual gasification and gas stream cleanup systems contractors review meeting: Volume 2.* 314p. Order Number DE93000229. Source: OSTI; NTIS.

The overall objective of the project is to obtain experimental data on the reactions of calcium-based sorbents in gasification systems and to evaluate or develop kinetic models applicable to the commercial design of such systems. Both air-blown coal gasification systems and second generation fluid bed combustion systems (partial gasification) will be investigated, as well as subsequent stabilization of the solid wastes (calcium sulfide/ash) produced. More specifically, the objectives are to: Develop data on kinetics of in-situ desulfurization reactions, Study the effect of calcium on the kinetics of carbon conversion rate, Study kinetics of oxidation of CaS to $CaSO_4$, Develop and identify viable techniques to stabilize CaS, and Carry out further development work on most promising method and determine its commercial economics.

25519 (DOE/METC–92/6128-Vol.2, pp. 515-523) **Measurements and modeling of advanced coal conversion processes.** Serio, M.A. (Advanced Fuel Research, Inc., East Hartford, CT (US)); Hamblen, D.G.; Brewster, B.S. USDOE Morgantown Energy Technology Center, WV (United States). Sep 1992. (CONF-920951–Vol.2: 12. annual gasification and gas stream cleanup systems contractors review meeting, Morgantown, WV (United States), 15-17 Sep 1992). In *Proceedings of the twelfth annual gasification and gas stream cleanup systems contractors review meeting: Volume 2.* 314p. Order Number DE93000229. Source: OSTI; NTIS.

The overall objective of this program is to understand the chemical and physical mechanisms in coal conversion processes and incorporate this knowledge in computer-aided reactor engineering technology for the purposes of development, evaluation, design, scale up, simulation, control and feedstock evaluation in advanced coal conversion devices. To accomplish this objective, the study will: establish the mechanisms and rates of basic steps in coal conversion processes, incorporate this information into comprehensive computer models for coal conversion processes, evaluate these models, and apply them to gasification, mild gasification and combustion in heat engines.

25520 (DOE/METC–92/6128-Vol.2, pp. 550-561) **Development of an advanced, continuous mild gasification process for the production of co-products.** Im, Chang J. (Coal Technology Corp., Bristol, VA (US)); Henkelman, M.R.; O'Neal, G.W.; Wolfe, R.A. USDOE Morgantown Energy Technology Center, WV (United States). Sep 1992. (CONF-920951–Vol.2: 12. annual gasification and gas stream cleanup systems contractors review meeting, Morgantown, WV (United States), 15-17 Sep 1992). In *Proceedings of the twelfth annual gasification and gas stream cleanup systems contractors review meeting: Volume 2.* 314p. Order Number DE93000229. Source: OSTI; NTIS.

The objective of this project is to develop a continuous mild gasification process to convert highly caking coals to coal liquids, char and coke for near term commercial application. Coal liquids after fractionation can be blended with petroleum and used interchangeably with conventional fuels without modifications in gasoline and diesel engines. Char can be used as a carbon source in the production of ferro-alloys and in mini-mills. Coke can be produced by upgrading char through briquetting and calcining and for use in the steel industry foundries and blast furnaces. In a step beyond the scope of the project, the plan is to finance, design and construct, in a partnership with others, a plant to produce coal liquids, char and coke in the initial range of 250,000 tons/year.

25521 (DOE/METC–92/6128-Vol.2, pp. 562-570) **Scaleup of mild gasification to a process development unit.** Carty, R.H. (Institute of Gas Technology, Chicago, IL (US)); Saladin, N.; Mead, J.; Foster, H. USDOE Morgantown Energy Technology Center, WV (United States). Sep 1992. (CONF-920951–Vol.2: 12. annual gasification and gas stream cleanup systems contractors review meeting, Morgantown, WV (United States), 15-17 Sep 1992). In *Proceedings of the twelfth annual gasification and gas stream cleanup systems contractors review meeting: Volume 2.* 314p. Order Number DE93000229. Source: OSTI; NTIS.

The overall objective of this project is to develop the IGT Mild-Gasification (MILDGAS) process for near-term commercialization. The specific objectives of the program are to: design, construct, and operate a 24-tons/day adiabatic process development unit (PDU) to obtain process performance data suitable for further design scaleup; obtain large batches of coal-derived co-products for industrial evaluation; prepare a detailed design of a demonstration unit develop technical and economic plans for commercialization of the MILDGAS process.

25522 (DOE/METC–92/6128-Vol.2, pp. 583-595) **Current status of design and construction of ENCOAL mild gasification plant.** Siddoway, M.A. (ENCOAL Corp., Gillette, WY (US)); Coolidge, D.W. USDOE Morgantown Energy Technology Center, WV (United States). Sep 1992. (CONF-920951–Vol.2: 12. annual gasification and gas stream cleanup systems contractors review meeting, Morgantown, WV (United States), 15-17 Sep 1992). In *Proceedings of the twelfth annual gasification and gas stream cleanup systems contractors review meeting: Volume 2.* 314p. Order Number DE93000229. Source: OSTI; NTIS.

The design and construction of the ENCOAL demonstration plant was done on a fast track basis, that is, these activities were extensively overlapped. An overall plot plan of the work site for convenient reference is shown. Even though the design work had just started, field construction crews mobilized in early October, 1990. By the end of the year, all of the major underground foundations were done and the first silo was poured. Although activity slowed during the winter, by the spring of 1992, the feed coal and PDF silos had been completed. All underground piping and equipment foundations were also done.

25523 (DOE/METC–92/6128-Vol.2, pp. 596-605) **Gasification product improvement facility (GPIF).** Sadowaki, R.S. (CRS Sirrine Engineers, Inc., Greenville, SC (US)); Skinner, W.H.; Brown,

M.J. USDOE Morgantown Energy Technology Center, WV (United States). Sep 1992. (CONF-920951–Vol.2: 12. annual gasification and gas stream cleanup systems contractors review meeting, Morgantown, WV (United States), 15-17 Sep 1992). In *Proceedings of the twelfth annual gasification and gas stream cleanup systems contractors review meeting: Volume 2.* 314p. Order Number DE93000229. Source: OSTI; NTIS.

The objective of this procurement is to provide a test facility to support early commercialization of advanced fixed-bed coal gasification technology for electric power generation applications. The proprietary CRS Sirrine Engineers, Inc. PyGas™ staged gasifier has been selected as the initial gasifier to be developed under this program. The gasifier is expected to avoid agglomeration when used on caking coals. It is also being designed to crack tar vapors and ammonia, and to provide an environment in which volatilized alkali may condense onto alumino silicates in the coal ash thereby minimizing their exiting with the hot raw coal gas and passing through the system to the gas turbine.

25524 (DOE/METC/C–93/7066) **Simulation of coal conversion in a circulating fluidized bed.** Syamlal, M. (EG and G/Washington Analytical Services Center, Inc., Albuquerque, NM (United States)); O'Brien, T.J. USDOE Morgantown Energy Technology Center, WV (United States). [1993]. 23p. Sponsored by USDOE, Washington, DC (United States). (CONF-930347–1: 7. annual conference on clean and efficient combustion of fossil fuels and toxic wastes, Park City, UT (United States), 2-5 Mar 1993). Order Number DE93013485. Source: OSTI; NTIS; GPO Dep.

A computer code, based on a multi-phase hydrodynamic model, has been developed at the morgantown Energy Technology Center (METC) for the detailed simulation of gas and particle dynamics in coal conversion processes. The particles, like the fluidizing gas, are described as interpenetrating continua. Different particle types are treated as distinct phases. Coupled three-dimensional, transient, partial differential equations, representing the conservation of mass, momentum and energy for each phase, are solved by this code, in either Cartesian or cylindrical coordinates. Constitutive laws have been developed to account for the exchange of momentum between phases ("drag") and interphase energy transfer. The stress within the granular phase is determined by a formulation based on the kinetic theory and is characterized by a "granular temperature." Recently, species balance equations were added to the code, so that it now has the capability of describing chemical reactions. The code has been tested by simulating several circulating fluidized bed reactors which are being studied at METC. This paper presents a brief description of the capabilities of the code, with some emphasis on its relationship to other hydrodynamic codes used for the simulation of coal conversion reactors, and preliminary results of the simulation of a chemically active riser.

25525 (DOE/PC/79815–T2) **Bioechnology of indirect liquefaction: Final report.** Datta, R.; Jain, M.K.; Worden, R.M.; Grethlein, A.J.; Soni, B.; Zeikus, J.G.; Grethlein, H. Michigan Biotechnology Inst., Lansing, MI (United States). 7 May 1990. 44p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-88PC79815. Order Number DE93014484. Source: OSTI; NTIS; GPO Dep.

The project on biotechnology of indirect liquefaction was focused on conversion of coal derived synthesis gas to liquid fuels using a two-stage, acidogenic and solventogenic, anaerobic bioconversion process. The acidogenic fermentation used a novel and versatile organism, Butyribacterium methylotrophicum, which was fully capable of using CO as the sole carbon and energy source for organic acid production. In extended batch CO fermentations the organism was induced to produce butyrate at the expense of acetate at low pH values. Long-term, steady-state operation was achieved during continuous CO fermentations with this organism, and at low pH values (a pH of 6.0 or less) minor amounts of butanol and ethanol were produced. During continuous, steady-state fermentations of CO with cell recycle, concentrations of mixed acids and alcohols were achieved (approximately 12 g/l and 2 g/l, respectively) which are high enough for efficient conversion in stage two of the indirect liquefaction process. The metabolic pathway to produce 4-carbon alcohols from CO was a novel discovery and is believed to be unique to our CO strain of B. methylotrophicum. In the solventogenic phase, the parent strain ATCC 4259 of Clostridium acetobutylicum was mutagenized using nitrosoguanidine and ethyl methane sulfonate. The E-604 mutant strain of Clostridium acetobutylicum showed improved characteristics as compared to parent strain ATCC 4259 in batch fermentation of carbohydrates.

25526 (DOE/PC/79936–T1) **Low severity conversion of activated coal: Final report.** Hirschon, A.S.; Ross, D.S. SRI International, Menlo Park, CA (United States). Jan 1990. 28p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-87PC79936. Order Number DE93012864. Source: OSTI; NTIS; GPO Dep.

The results suggest that coal contains regions with structural components significantly reactive under the hydrothermal environment. Although the specific mechanism for this process remains to be developed, this activity is reminiscent of findings in studies of accelerated maturation of oil shale, where hydrothermal treatment (hydrous pyrolysis) leads to the production of petroleum hydrocarbons. In line with what has been seen in the oil shale work, the pretreatment-generated hydrocarbons and phenols appear to represent a further or more complete maturation of some fraction of the organic material within the coal. These observations could have an impact in two areas. The first is in the area of coal structure, where immature, reactive regions have not been included in the structures considered at present. The second area of interest is the more practical one of conversions to coal liquids and pyrolytic tars. It seems clear that the hydrothermal pretreatment changes the coal in some manner that favorably affects the product quality substantially and, as in the CO/water liquefaction case, favorably affects the yields. The conversions of coals of lower rank, i.e., less mature coals, could particularly benefit in terms of both product quality and product quantity. The second portion of this project also shows important benefits to coal conversion technology. It deals with synthesizing catalysts designed to cleave the weak links in the coal structure and then linking these catalysts with the pretreatment methods in Task 2. The results show that highly dispersed catalysts can effectively be used to increase the yields of soluble material. An important aspect of highly dispersed catalysts are that they can effectively catalyze coal conversion even in poor liquefaction solvents, thus making them very attractive in processes such as coprocessing where inexpensive liquefaction media such as resids are used.

25527 (DOE/PC/88811–T17) **Fundamental reaction pathways during coprocessing.** Stock, L.M. (Chicago Univ., IL (United States). Dept. of Chemistry); Gatsis, J.G. Chicago Univ., IL (United States). Dept. of Chemistry; Universal Oil Products Co., Des Plaines, IL (United States). Dec 1992. 98p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-88PC88811. Order Number DE93014507. Source: OSTI; NTIS; GPO Dep.

The objective of this research was to investigate the fundamental reaction pathways in coal petroleum residuum coprocessing. Once the reaction pathways are defined, further efforts can be directed at improving those aspects of the chemistry of coprocessing that are responsible for the desired results such as high oil yields, low dihydrogen consumption, and mild reaction conditions. We decided to carry out this investigation by looking at four basic aspects of coprocessing: (1) the effect of fossil fuel materials on promoting reactions essential to coprocessing such as hydrogen atom transfer, carbon-carbon bond scission, and hydrodemethylation; (2) the effect of varied mild conditions on the coprocessing reactions; (3) determination of dihydrogen uptake and utilization under severe conditions as a function of the coal or petroleum residuum employed; and (4) the effect of varied dihydrogen pressure, temperature, and residence time on the uptake and utilization of dihydrogen and on the distribution of the coprocessed products. Accomplishments are described.

25528 (DOE/PC/88933–T2) **Alkali/TX_2 catalysts for CO/H_2 conversion to C_1-C_4 alcohols: Final technical progress report, September 1, 1988–August 31, 1991.** Klier, K.; Herman, R.G.; Richards-Babb, M.; Bastian, R.; Kieke, M. Lehigh Univ., Bethlehem, PA (United States). Mar 1993. 357p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-88PC88933. Order Number DE93012403. Source: OSTI; NTIS; GPO Dep.

The objective of this research is to determine the patterns of variations of catalyst activity and selectivity for the synthesis of alcohols from H_2/CO synthesis gas. Since the source of carbon can be coal-derived synthesis gas, this research makes a contribution to the technology for high quality clean transportation fuels and for basic chemicals from coal. Catalysts prepared were principally based on MoS_2, RuS_2, TaS_2, and NbS_2. Catalytic testing of these materials was carried out both before and after surface doping with Cs. In alcohol synthesis activation of hydrogen by the catalyst surface is essential. Knowledge of transition metal disulfide surface properties is important before the mechanism of hydrogen dissociation can be addressed. The electronic structures of MoS_2, RuS_2, and NbS_2 were studied both theoretically and experimentally. Experimental valence bands were obtained by high resolution electron spectroscopy for chemical analysis (HR-ESCA, also referred to as x-ray photoelectron spectroscopy) and theoretical valence bands were calculated using solid state extended Hueckel theory. Comparison of two-dimensional (2-D) MoS_2 theoretical valence bands with the experimental HR-ESCA valence bands of polycrystalline MoS_2 led to parametrization of the S 3s, S 3p, and Mo 4d atomic ionization potentials and Slater-type coefficients and exponents. The S 3s and S 3p parameters obtained for MoS_2 were used to obtain the NbS_2 and RuS_2 theoretical valence bands.

25529 (DOE/PC/89767–T11) **Novel technique for coal pyrolysis and hydrogenation product analysis: Final technical report.** Pfefferle, L.D.; Boyle, J. Yale Univ., New Haven, CT (United States). Dept. of Chemical Engineering. 15 Mar 1993. 61p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-89PC89767. Order Number DE93013074. Source: OSTI; NTIS; GPO Dep.

A microjet reactor coupled to a VUV photoionization time-of-flight mass spectrometer has been used to obtain species measurements during high temperature pyrolysis and oxidation of a wide range of hydrocarbon compounds ranging from allene and acetylene to cyclohexane, benzene and toluene. Initial work focused on calibration of the technique, optimization of ion collection and detection and characterization of limitations. Using the optimized technique with 118 nm photoionization, intermediate species profiles were obtained for analysis of the hydrocarbon pyrolysis and oxidation mechanisms. The "soft" ionization, yielding predominantly molecular ions, allowed the study of reaction pathways in these high temperature systems where both sampling and detection challenges are severe. Work has focused on the pyrolysis and oxidative pyrolysis of aliphatic and aromatic hydrocarbon mixtures representative of coal pyrolysis and hydropyrolysis products. The detailed mass spectra obtained during pyrolysis and oxidation of hydrocarbon mixtures is especially important because of the complex nature of the product mixture even at short residence times and low primary reactant conversions. The combustion community has advanced detailed modeling of pyrolysis and oxidation to the C4 hydrocarbon level but in general above that size uncertainties in rate constant and thermodynamic data do not allow us to a priori predict products from mixed hydrocarbon pyrolyses using a detailed chemistry model. For pyrolysis of mixtures of coal-derived liquid fractions with a large range of compound structures and molecular weights in the hundreds of amu the modeling challenge is severe. Lumped models are possible from stable product data.

25530 (DOE/PC/89865–T6) **Synthesis of dimethyl ether and alternative fuels in the liquid phase from coal-derived synthesis gas: Task 2.2: Definition of preferred catalyst system; Task 2.3: Process variable scans on the preferred catalyst system; Task 2.4: Life-test on the preferred catalyst system.** Bhatt, B.L. Air Products and Chemicals, Inc., Allentown, PA (United States). Sep 1992. 78p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-90PC89865. Order Number DE93011700. Source: OSTI; NTIS; GPO Dep.

As part of the DOE-sponsored contract for the Synthesis of Dimethyl Ether (DME) and Alternative Fuels in the Liquid Phase from Coal- Derived Syngas, the single-step, slurry phase DME synthesis process was developed. The development involved screening of catalyst systems, process variable studies, and catalyst life studies in two 300 ml stirred autoclaves. As a spin-off of the Liquid Phase Methanol (LPMEOH") process, the new process significantly improves the syngas conversion efficiency of the LPMEOH process. This improvement can be achieved by replacing a portion of methanol catalyst with a dehydration catalyst in the reactor, resulting in the product methanol being converted to DME, thus avoiding the thermodynamic equilibrium constraint of the methanol reaction. Overall, this increases syngas conversion per-pass. The selectivity and productivity of DME and methanol are affected by the catalyst system employed as well as operating conditions. A preferred catalyst system, consisting of a physical mixture of a methanol catalyst and a gamma alumina, was identified. An improvement of about 50% in methanol equivalent productivity was achieved compared to the LPMEOH process. Results from the process variable study indicate that higher pressure and CO_2 removal benefit the process significantly. Limited life studies performed on the preferred catalyst system suggest somewhat higher than expected deactivation rate for the methanol catalyst. Several DME/methanol mixtures were measured for their key properties as transportation fuels. With small amounts of DME added, significant improvements in both flash points and Reid Vapor Pressure (RVP) were observed over the corresponding values of methanol alone.

25531 (DOE/PC/89865–T7) **Synthesis of dimethyl ether and alternative fuels in the liquid phase from coal-derived synthesis gas: Task 3.2: Screen novel catalyst systems; Task 3.3:, Evaluation of the preferred catalyst system.** Underwood, R.P. Air Products and Chemicals, Inc., Allentown, PA (United States). Jan 1993. 77p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-90PC89865. Order Number DE93013075. Source: OSTI; NTIS; GPO Dep.

As part of the DOE-sponsored contract "Synthesis of Dimethyl Ether and Alternative Fuels in the Liquid Phase from Coal-Derived Syngas" experimental evaluations of the one-step synthesis of alternative fuels were carried out. The objective of this work was to develop novel processes for converting coal-derived syngas to fuels or fuel additives. Building on a technology base acquired during the development of the Liquid Phase Methanol (LPMEOH) process, this work focused on the development of slurry reactor based processes. The experimental investigations, which involved bench-scale reactor studies, focused primarily on three areas: (1) One-step, slurry-phase syngas conversion to hydrocarbons or methanol/hydrocarbon mixtures using a mixture of methanol synthesis catalyst and methanol conversion catalyst in the same slurry reactor. (2) Slurry-phase conversion of syngas to mixed alcohols using various catalysts. (3) One-step, slurry-phase syngas conversion to mixed ethers using a mixture of mixed alcohols synthesis catalyst and dehydration catalyst in the same slurry reactor. The experimental results indicate that, of the three types of processes investigated, slurry phase conversion of syngas to mixed alcohols shows the most promise for further process development. Evaluations of various mixed alcohols catalysts show that a cesium-promoted $Cu/ZnO/Al_2O_3$ methanol synthesis catalyst, developed in Air Products' laboratories, has the highest performance in terms of rate and selectivity for C_{2+}-alcohols. In fact, once-through conversion at industrially practical reaction conditions yielded a mixed alcohols product potentially suitable for direct gasoline blending. Moreover, an additional attractive aspect of this catalyst is its high selectivity for branched alcohols, potential precursors to iso-olefins for use in etherification.

25532 (DOE/PC/89876–T18) **Biological production of ethanol from coal: Final report.** Arkansas Univ., Fayetteville, AR (United States). Dept. of Chemical Engineering. Dec 1992. 298p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-89PC89876. Order Number DE93014938. Source: OSTI; NTIS; GPO Dep.

Due to the abundant supply of coal in the United States, significant research efforts have occurred over the past 15 years concerning the conversion of coal to liquid fuels. Researchers at the University of Arkansas have concentrated on a biological approach to coal liquefaction, starting with coal-derived synthesis gas as the raw material. Synthesis gas, a mixture of CO, H_2, CO_2, CH_4 and sulfur gases, is first produced using traditional gasification techniques. The CO, CO_2 and H_2 are then converted to ethanol using a bacterial culture of Clostridium 1jungdahlii. Ethanol is the desired product if the resultant product stream is to be used as a

liquid fuel. However, under normal operating conditions, the "wild strain" produces acetate in favor of ethanol in conjunction with growth in a 20:1 molar ratio. Research was performed to determine the conditions necessary to maximize not only the ratio of ethanol to acetate, but also to maximize the concentration of ethanol resulting in the product stream.

25533 (DOE/PC/90033–23) **Run 263 with Black Thunder Mine subbituminous coal and dispersed molybdenum catalysts: Technical progress report.** Southern Co. Services, Inc., Birmingham, AL (United States); Southern Electric International, Inc., Wilsonville, AL (United States). Dec 1992. 298p. Sponsored by USDOE, Washington, DC (United States); Electric Power Research Inst., Palo Alto, CA (United States). DOE Contract AC22-90PC90033. RP1234-1-2. Order Number DE93011539. Source: OSTI; NTIS; GPO Dep.

This report presents the results of Run 263 performed at the Advanced Coal Liquefaction R&D Facility in Wilsonville, Alabama. The run started on October 31, 1991 and continued until February 23, 1992. Tests were conducted by operating the reactors in the Close-Coupled Integrated Two-Stage Liquefaction mode and by processing Black Thunder Mine subbituminous coal from Wyodak-Anderson seam in Wyoming Powder River Basin. Half volume reactors were used for the entire run. In the first part of Run 263, a dispersed molybdenum catalyst was evaluated for its performance without a supported catalyst in the second stage. Molyvan L and Molyvan 822 (commercially available as friction reducing lubricants) were used as precursors for the dispersed molybdenum catalyst. The effect of the dispersed catalyst on eliminating the solids buildup was also evaluated. For the second part of the run, the hybrid catalyst system was tested with supported Criterion 324 1/1611 catalyst in the second stage at catalyst replacement rates of 2 and 3 lb/ton of MF coal. The molybdenum concentration was 100–200 ppm based on MF coal. Iron oxide was used as a slurry catalyst precursor at a rate of 1–2 wt % MF coal throughout the run with dimethyl disulfide (DMDS) as the sulfiding agent. The close-coupled reactor unit was on-stream for 2482 hours for an on-stream factor of 91.2% and the ROSE-SR^{sm} unit was on-feed for 2126 hours for an on-stream factor of 96.4% for the entire run.

25534 (DOE/PC/90307–7) **Reactivity of young chars via energetic distribution measurements: Quarterly technical progress report, 15 March 1992–30 June 1992.** Calo, J.M.; Zhang, L.H.; Lilly, W.D. Brown Univ., Providence, RI (United States). Div. of Engineering. [1992]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-90PC90307. Order Number DE93017010. Source: OSTI; NTIS; GPO Dep.

The correlation and prediction of kinetic rates and mechanisms of the reactions of gas phase species with coal chars represent a difficult undertaking under the best of circumstances. Solid phase heterogeneity and impurities, complex pore structure, transport limitation, and evolution of active surface represent just a few of the well known problems. Temperature programmed desorption (TPD) has become a standard technique for investigating the physics-chemical state of adsorbed species on surfaces. The TPD spectra usually consist of one or more peaks. The shapes of the peaks and the position of the peak maxima with respect to temperature are related in a fundamental manner to the desorption process, and, therefore, provide basic information regarding the energetics of the desorbed species. The current project is directed at developing related techniques for the characterization and prediction/correlation of the reactivity of "young" chars to steam and oxygen. Of particular interest is mapping of the reactivity behavior of the resultant chars, as revealed by the energetic heterogeneity of the complexes with char preparation conditions; i.e., heating rate and ultimate temperature. Progress is described.

25535 (DOE/PC/90307–8) **Reactivity of young chars via energetic distribution measurements: Quarterly technical progress report, 1 July 1992–30 September 1992.** Calo, J.M.; Zhang, L.H.; Lilly, W.D. Brown Univ., Providence, RI (United States). Div. of Engineering. [1992]. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-90PC90307. Order Number DE93017011. Source: OSTI; NTIS; GPO Dep.

The correlation and prediction of kinetic rates and mechanisms of the reactions of gas phase species with coal chars represent a difficult undertaking under the best of circumstances. Solid phase heterogeneity and impurities, complex pore structure, transport limitation, and evolution of active surface represent just a few of the well known problems. Temperature programming desorption (TPD) has become a standard technique or investigating the physics-chemical state of adsorbed species on surfaces. The TPD spectra usually consist of one or more peaks. The shapes of the peaks and the position of the peak maxima with respect to temperature are related in a fundamental manner to the desorption process, and therefore, provide basic information regarding the energetics of the desorbed species. The current project is directed at developing related techniques for the characterization and prediction/correlation of the reactivity of "young" chars to steam and oxygen. Of particular interest is mapping of the reactivity behavior of the resultant chars, as revealed by the energetic heterogeneity of the complexes with char preparation conditions; i.e., heating rate and ultimate temperature.

25536 (DOE/PC/90312–T10) **Hot gas desulfurization with sorbents containing mixed metal oxides: Final report, October 1, 1990–December 31, 1992.** Akyurtlu, A.; Akyurtlu, J.F. Hampton Univ., VA (United States). Dept. of Engineering. [1992]. 114p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-90PC90312. Order Number DE93017044. Source: OSTI; NTIS; GPO Dep.

In this project the sulfidation and regeneration behavior of vanadium-promoted zinc ferrite sorbents was investigated by microreactor studies and physical characterization of the promoted sorbents. The discussion of results are presented for the fresh and used sorbent characterizations Zn-Fe-V-O, and standard sulfidation and regeneration experiments followed by the discussion of the effects of sulfidation temperature, calcination temperature, and the water vapor content of the simulated fuel gas.

25537 (DOE/PC/90537–T1) **Sequential low-temperature depolymerization and liquefaction of US coals: Progress report No. 1, October 1–December 31, 1986.** Shabtai, J.S.; Wiser, W.H. Utah Univ., Salt Lake City, UT (United States). Dept. of Fuels Engineering. Jan 1987. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-86PC90537. Order Number DE93015630. Source: OSTI; NTIS; GPO Dep.

Results obtained in the studies with BS(IL) coal as feed can be summarized as follows: (1) The low-temperature depolymerization - liquefaction procedure, summarized in Figure 1, is easily adaptable and applicable to a high-sulfur, Burning Star (Illinois No. 6) coal sample. The final product obtained consists of a fully desulfurized, light hydrocarbon oil. (2)Suitable processing conditions for each step of the stepwise depolymerization - liquefaction of the above coal were determined. (3)Direct hydroprocessing of the Burning Star (Illinois No. 6) coal with sulfided catalysts is ineffective for its conversion into a light hydrocarbon product. In accordance with the research program the depolymerized, THF-soluble coal products will be subjected to detailed analysis for the purpose of deriving average molecular structures for the oil, asphaltene and asphaltol fractions. The data obtained will be used to develop a structural model for the BS(IL) coal.

25538 (DOE/PC/91054–T6) **Effect of pretreating of host oil on coprocessing: Quarterly progress report, January 1, 1993–March 31, 1993.** Wender, I.; Tierney, J.W. Pittsburgh Univ., PA (United States). Dept. of Chemical and Petroleum Engineering. 11 May 1993. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-91PC91054. Order Number DE93016858. Source: OSTI; NTIS; GPO Dep.

The principal objective of this research is to determine the role that host petroleum-derived oils (1000 °F$^+$), as that of catalytically treated host oils, play when used as liquefaction solvents in coprocessing with coal. The host oils will be extensively characterized and then pretreated in a number of ways which involve catalytic reactions such as hydrogenation, hydrocracking, and isomerization. The pretreated oils will then be characterized by elemental analysis, catalytic dehydrogenation, and NMR. The effects of the host oil on coprocessing with coal will be compared to those obtained using catalytically modified heavy oils. When appropriate, model compounds will be used to study specific reactions brought about by the pretreatments. A total of 18 pretreatment runs have been

made on an AMOCO vacuum tower residuum, VTR, in an attempt to increase its hydrogen content from 10.2 wt % to a level of about 11.5%. This pretreatment resulted in a significant increase in the hydrogen content of the starting oil (10.2 wt % to 11.2%).

25539 (DOE/PC/91257–T16) **Molten-Caustic-Leaching (Gravimelt) System Integration Project, Phase 2: Topical report for test circuit operation.** TRW Space and Technology Group, Redondo Beach, CA (United States). Applied Technology Div. Feb 1993. 140p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-86PC91257. Order Number DE93013617. Source: OSTI; NTIS; GPO Dep.

The objective of the task (Task 6) covered in this document was to operate the refurbished/modified test circuit of the Gravimelt Process in a continuous integrated manner to obtain the engineering and operational data necessary to assess the technical performance and reliability of the circuit. This data is critical to the development of this technology as a feasible means of producing premium clean burning fuels that meet New Source Performance Standards (NSPS). Significant refurbishments and design modifications had been made to the facility (in particular to the vacuum filtration and evaporation units) during Tasks 1 and 2, followed by off-line testing (Task 3). Two weeks of continuous around-the-clock operation of the refurbished/modified MCL test circuit were performed. During the second week of testing, all sections of the plant were operated in an integrated fashion for an extended period of time, including a substantial number of hours of on-stream time for the vacuum filters and the caustic evaporation unit. A new process configuration was tested in which centrate from the acid wash train (without acid addition) was used as the water makeup for the water wash train, thus-eliminating the one remaining process waste water stream. A 9-inch centrifuge was tested at various solids loadings and at flow rates up to 400 lbs/hr of coal feed to obtain a twenty-fold scaleup factor over the MCL integrated test facility centrifuge performance data.

25540 (DOE/PC/91257–T17) **Molten-Caustic-Leaching (Gravimelt) System Integration Project, Phase 2: Topical report for test circuit maintenance, refurbishment, modification, and off-line operation.** TRW Space and Technology Group, Redondo Beach, CA (United States). Applied Technology Div. Mar 1993. 162p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-86PC91257. Order Number DE93013616. Source: OSTI; NTIS; GPO Dep.

This is a report of the maintenance, refurbishment, modifications, and off-line circuit component testing of the integrated test circuit of the Molten-Caustic-Leaching (MCL or Gravimelt) process for the desulfurization and demineralization of coal. The project is sponsored by the Pittsburgh Energy Technology Center of the US Department of Energy under Contract No. DE-AC22-86-PC91257.

25541 (LBL–33769) **Fundamental studies of the mechanism of catalytic reactions with catalysts effective in the gasification of carbon solids and the oxidative coupling of methane: Quarterly report, January 1, 1993–March 31, 1993.** Heinemann, H.; Somorjai, G.A.; Perry, D.L. Lawrence Berkeley Lab., CA (United States). Mar 1993. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. Order Number DE93015265. Source: OSTI; NTIS; GPO Dep.

Work continued on the development of catalysts for the steam gasification of chars and for the oxidative coupling of methane. Testing of the catalysts Ni-Ca-K-oxides and Co-Ca-K-oxides are described for gasification research; results of the testing of a Co-Mg-oxide catalysts for methane conversion are also described.

25542 (NUTEK-FGT–93-1) **Gasification LTH, Stage 8. Final report.** Andersson, Lars (Lund Inst. of Tech. (Sweden). Dept of Chemical Technology); Bjerle, I.; Hellgren, R.; Johansson, Anders; Karlegaerd, Aa.; Lindblom, M. Swedish National Board for Industrial and Technical Development (NUTEK), Stockholm (Sweden). 1993. 206 p.p. (In Swedish). Project NUTEK-136-026. Order Number DE93500741. Source: OSTI; NTIS.

This final report is divided into 8 independent sections, and 6 of them have their own table of contents. The content of the different sections are: Determination of calorific value for gas, using catalytic combustion and lambda sond; Ammonia removal from gasification gas. A literature survey; Introductory desulfurization experiments with zinc-ferrite. Experimental results; Hot gas desulfurization with zinc-ferrite. Experimental results; Characterization of liquid and chars produced through high temperature pyrolysis of wood; 13C-NMR characterization of tar liquids and wood chars; Implementation of decomposition kinetics in wood in simulation of a drop-tube furnace; Literature survey Gasification of Biomass - Commentary and reference.

25543 (NUTEK-FGT–93-2) **Partial gasification PFBC, Stage 2. Final report.** Sjoestroem, K. (Royal Inst. of Tech., Stockholm (Sweden). Dept. of Chemical Technology). Swedish National Board for Industrial and Technical Development (NUTEK), Stockholm (Sweden); Royal Inst. of Tech., Stockholm (Sweden). Dept. of Chemical Technology. 1993. 30p. (In Swedish). Project NUTEK-276-367. (TRITA-KT–92-3). Order Number DE93500745. Source: OSTI; NTIS.

ABB has developed a pressurized fluidized bed combustion process (PFBC). This project is a part of the continued development for enhanced process efficiency and improved environmental performance of this process. The process efficiency can be enhanced by increasing the gas turbine inlet temperature. The temperature in the combustion chamber cannot be increased due to the resulting prohibitively high alkali concentrations. This problem can be by-passed through of a topping gas to the combustion chamber exhausts and eventual combustion in an afterburner. The topping gas will be from partial gasification of the coal in a separate pyrolysis reactor. In the described process concept sulfur will be absorbed on dolomite in the combustion bed. Sulfur emissions will then mainly be the result of organic sulfur in the tar fraction of the pyrolysis gas. As sulfur only can be absorbed on dolomite as hydrogen sulfide the organic sulfur compounds must be decomposed into hydrogen sulfide and hydrocarbons. It is known that half calcined dolomite ($CaCO_3$ MgO) has the best sulfur capturing capacity. The dolomite also has tar cracking capacity which is of importance in the cracking of the organic sulfur compounds such as thiophene.

25544 (Riso-R–669(EN)) **Using the distributed activation energy model to interpret oxidative coal pyrolysis experiments performed by flat-flame burner, entrained-flow reactor and thermogravimetric analyzer.** Holst Soerensen, L. (Risoe National Laboratory, Department of Combustion Research, Roskilde (Denmark)); Biede, O.; Peck, R.E. Risoe National Lab., Roskilde (Denmark). Combustion Dept. May 1993. 71 p.p. Contract EM-1323/88-23. Order Number DE93500191. Source: OSTI; NTIS; Also available from Risoe Library, P.O. Box 49, DK-4000 Roskilde, Denmark.

EFP-88.

Coal pyrolysis experiments with a Flat Flame Burner an Entrained Flow Reactor and a Thermogravimetric Analyzer has been done on a Pittsburg 8 coal-type. The instruments offer extremely different conditions with respect to environment for- and heating rate of the particles examined. Each individual instrument provide characteristic results. The results obtained from each of the instruments are combined to provide a better background for modelling the pyrolysis of the coals under varying conditions. A procedure for using the Distributed Activation Energy (DAE) model to describe coal devolatilization in a flame is proposed. It is described how to calibrate and test the DAE model from experiments performed with a Flat-Flame Burner and an Entrained-Flow Reactor. The model enabled realistic predictions of devolatilization characteristics for a Pittsburg 8 coal dust for a range of heating/oxidizing environments. The results indicate that for rapid heating (10^5K/s) release of primary volatiles occurred within 3-10 ms and before calculated particle peak temperatures of 1200-1500K were reached. The calibrated DAE-model approach combined with a model describing the heat balance for a coal particle in a hot environment, allows comparison of coal particle conversion rates due to kinetic reaction rates and mass- and heat transfer effects. Reported kinetic parameters derived under inert slow heating rate conditions by thermogravimetry (TGA) were shown to be applicable under high heating rate conditions. However with the calibrated data applicable for the Flat Flame Burner experiments lower temperature yields obtained by an Entrained Flow Reactor were underestimated. This showed that the simple DAE-model is not able to cover a large temperature regime

when high heating rates are applied. A comparison between the TGA proximate volatiles of the coal and the chars processed in the Flat-Flame Burner is performed. (Abstract Truncated)

0105 Products and By-Products

Refer also to citation(s) 26791

0106 Properties and Composition

Refer also to citation(s) 25481, 25563, 25564, 25565, 25566, 25567, 25568, 25569, 25570, 25571

25545 (CONF-880912–35) **Coal structure and behavior: Interfacial chemistry in coal.** Ross, D.S.; Hirschon, A.S.; Green, T.K. SRI International, Menlo Park, CA (United States). [1988]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-87PC79936. From 196. American Chemical Society (ACS) national meeting; Los Angeles, CA (United States); 25-30 Sep 1988. Order Number DE93012935. Source: OSTI; NTIS; GPO Dep.

In an attempt to evaluate the importance of interfacial chemistry to coal behavior, we have conducted studies at 400°C with both H_2O and D_2O, using both Illinois No. 6 coal (PSOC 1098) and pure organic compounds. Figure 3 summarizes our effort, and virtually none of the material presented here is consistent with the organic structures depicted in Figure 1. We found that while coal recovered from simple hydrothermal treatment in D_2O/N_2 for 20 minutes under nitrogen contained more than 90% of the starting carbon, 36% of the starting hydrogen and about half the starting oxygen were lost. Our account of the anomalous O-loss has recently appeared (2). These loses could not be accounted for by CO_x and light hydrocarbon evolution. Of the remaining protium in the product, 53% had been exchanged for deuterium. The product had been subjected to back-exchange in H_2O at mild conditions to convert the phenolic hydrogen to protium, so the large levels of exchange were strictly for hydrogen bonded to carbon. These findings can be compared with those from work with work under the same conditions with pure organic materials. At 20 minutes in D_2O we found no trace of exchange for benzene, toluene, or bibenzyl. Thus, the benzyl-protium exchange rate in coal is roughly 100 times faster than that for bibenzyl and considerably faster than that for toluene. This result can be translated to suggest that the thermal generation of free radical sites in the coal operates at a rate two to three orders of magnitude greater than that for bibenzyl. However no feature in the organic structures proposed for coal can generate such a flux of reactive free radicals by a wide margin.

25546 (DOE/PC/91283–T7) **Liquid chromatographic analysis of coal surface properties: Quarterly progress report, January–March 1993.** Kwon, K.C.; Rigby, R. Tuskegee Univ., AL (United States). Dept. of Chemical Engineering. 1993. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-91PC91283. Order Number DE93017023. Source: OSTI; NTIS; GPO Dep.

Research continued on coal surface properties. Experiments on equilibrium adsorption loadings of various probe compounds on 60–200 mesh Illinois #6 coal (PSOC-1539), Adaville #1 coal (PSOC-1544), Wyodak coal (PSOC-1545) and Pittsburgh#8 coal (PSOC-1549) were performed during the January–March period. The probe compounds include m-cresol, p-cresol, n-octanol, n-heptanol, n-butanol, phenol and toluene.

25547 (NEI-DK–1192) **Determination and correlation of coal data. Volume 1: Petrographical and chemical coal characterisation. Final report. Text.** Energiministeriets Energiforskningsprogram. Braendsler og forbraendingsteknik. Thomsen, E.; Rosenberg, P.; Boiesen-Koefoed, J.; Guvad, C. Danmarks Geologiske Undersoegelske, Copenhagen (Denmark). Nov 1992. 163p. Contract EM-1323/87-16. Order Number DE93500115. Source: OSTI; NTIS.

EFP-87.

The aim was to investigate the combustion reactivity of coal chars in pulverized coal-fired power plant boilers as it is measured by different laboratory scale methods, and possible correlations between results obtained using these methods. The overall aim was, through the correlation of advanced and more simplistic analytical methods, to find methods that could improve the prediction of coal char reactivity. Ten types of coal were selected for detailed petrographical and chemical analysis. These were Cerreion, Blair Atholl, Ulan, Blue 1, Dietz, Illinois 6, Colorado Bas. B., Hiawatha and Lower Kittaning. A thorough characterization of the raw coals using routine chemical and petrographical methods supplemented with a few more advanced techniques was carried out. Results showed marked differences in the content and composition of the ash, the petrographic composition and the rank conditions. Combustion problems have been attributed to the content, distribution and composition of the mineral matter in the coal. The results and conclusions of these investigations are presented in great detail. (AB) (57 refs.).

25548 (NEI-DK–1214) **Determination and correlation of coal data. Volume 2: Petrographical and chemical coal characterisation. Final report. Appendix.** Energiministeriets Energiforskningsprogram. Braendsler og forbraendingsteknik. Thomsen, E.; Rosenberg, P.; Boiesen-Koefoed, J.; Guvad, C. Danmarks Geologiske Undersoegelske, Copenhagen (Denmark). Nov 1992. [164 p.p.] Contract EM-1323/87-16. Order Number DE93500372. Source: OSTI; NTIS.

EFP-87.

Short communication COAL/chemical analysis; COAL; IMAGES; PETROGRAPHY; EXPERIMENTAL DATA; REFLECTION; DIAGRAMS

25549 (NUTEK-TORV–93-1) **Characterization of peat. Project report.** Bergner, K. (National lab. of agricultural sciences, Umeaa (Sweden) and Swedish Univ. of Agricultural Sciences, Umeaa (Sweden)). Swedish National Board for Industrial and Technical Development (NUTEK), Stockholm (Sweden). 1993. 32p. (In Swedish). Project NUTEK-216-088. Order Number DE93500749. Source: OSTI; NTIS.

This report is a summary of the fourth period (1990-1992) of a research project about fundamental studies of peat characterization. In order to obtain a broad and fundamental understanding of peat and peat-water relationships, the project covers several different scientific areas. Each area has in turn comprised several subprojects. During the first period, the major efforts were to establish good characterization methods (biological, chemical) and to establish a good working knowledge about established methods for peat dewatering. In the second and third period this work was extended into more detailed studies of specific problems. The project represents the restart of basic peat research in Sweden, and much of the work so far has served to reestablish fundamental peat knowhow. In doing so, traditional methods have been reviewed, but in addition some very recent methodological developments have been adopted. The experience gained while studying peat with these methods will also be useful in a wider context. The basic idea of the project has been to obtain a fairly 'complete' description of peat. The project has an integrated approach which means that several subprojects are done with participation from different parts of the project.

0108 Waste Management

Refer also to citation(s) 25561, 25575, 27354

25550 (EPRI-TR–101774-Vol.2, pp. 37.1-37.15) **Fly ash in concrete: An overview of more than 30 years of experience in the United Kingdom.** Thomas, M.D.A. (Ontario Hydro, Toronto (CA)); Owens, P.L.; Cripwell, J.B. Electric Power Research Inst., Palo Alto, CA (United States); American Coal Ash Association, Washington, DC (United States). Jan 1993. (CONF-930146–Vol.2: 10. international symposium on coal ash use and disposal, Orlando, FL (United States), 18-21 Jan 1993). In *Proceedings: Tenth international ash use symposium: Volume 2, Ash use R&D and clean coal by-products.* 588p. Source: EPRI Distribution Center, 207 Coggins Drive, PO Box 23205, Pleasant Hill, CA 94523.

This paper presents an historical account of the use of fly ash in UK concrete construction. Research findings are charted from the

first studies on the compressive strengths to the more recent concerns of long-term durability in aggressive environments and the ability of fly ash to suppress damage alkali-aggregate reaction. Major achievements in the field of concrete construction from the early use of non-classified ash to reduce temperature rises and cement costs in large dams to the specification of high-performance fly ash concrete to meet the rigorous demands of 120-year design life in marine environments. The development of British Standards for the specification of fly. ash for use in concrete are also discussed. It is concluded that the abundant evidence from the laboratory and field together with the existence of a onerous specification to control variability should provide engineers with the confidence to use fly ash to generally improve the quality of concrete construction.

25551 (ETDE/JP-mf–93798681, pp. 7-13) **Coal-chemical prospects on preventing NOx and SOx generation in coal combustion.** Takarada, Y. (Gunma University, Gunma (Japan). Faculty of Engineering). 20 Jan 1993. 94p. (In Japanese). In *Symposium on global environmental conservation and air pollution prevention technology.* Order Number DE93798681. Source: OSTI; NTIS (US Sales Only).

Developing a technology at even higher level for burning coal with establishing its exhaust gas reduction measures becoming increasingly more important requires discussions on coals at molecular levels based on coal chemistry. From this viewpoint, this paper introduces latest researches on desulfurization with a fluidized bed furnace utilizing calcium loaded brown coal, and on an approach to NOx generation from coal structures (elucidating temperature dependence of NOx discharge through measuring bonding patterns of nitrogen in coals). Specifically speaking on the former research for example, it attempts improving the fluidized bed combustion that is low in the utilization rate of desulfurizing agent in furnace (limestone) requiring a large amount of limestone in spite of many features of the process, by means of burning a mixture of coal with brown coal loaded with calcium through ion exchange process to remove SO2. A precision experiment using a thermo-balance and a continuous combustion experiment using a small circulation fluidized bed showed a remarkable effect of calcium loaded coal. It was indicated that this is because of CaO particles in ash from the calcium loaded coal being very small in size. 5 refs., 9 figs., 3 tabs.

25552 (ETDE/JP-mf–93798681, pp. 24-29) **Desulfurization and denitrification technologies suitable for developing countries.** Sadakata, M. (The University of Tokyo, Tokyo (Japan). Faculty of Engineering). 20 Jan 1993. 94p. (In Japanese). In *Symposium on global environmental conservation and air pollution prevention technology.* Order Number DE93798681. Source: OSTI; NTIS (US Sales Only).

This paper introduces the actual situation of environmental contamination observed during a visit to the city of Chungching, China, and presents a view and a proposal to solving environmental problems in developing countries. The maximum concentration of SO2 in Chungching City has reached as high as 2 mg/Nm^3, so has smoke and soot concentration similarly high, and impediments to human health have emerged clearly. Small factories and households cannot be ignored as generation sources. Several thousand units of air bubble type fluidized bed have been installed as a measure to reduce generation of contaminants, but nearly all has ended in failure. The reason for this is reportedly because of use of insufficiently cleaned coal and severe wear of heat exchangers. Four pieces of gypsum-based desulfurizer have been installed, but the gypsum utility has been low and none of the equipment is in operation now. The key to developing the Chinese economy is to improve agricultural productivity, where development of such technologies are wanted as a simplified desulfurization process that can produce ammonium sulfate fertilizer as a by-product, a desulfurization technology that can improve heat efficiency in stoker firing systems that account for the majority of the currently used systems, and pre-desulfurization and gasification technologies that suit Chinese coals. 1 ref., 2 figs., 2 tabs.

25553 (ETDE/JP-mf–93798681, pp. 35-41) **Dedusting performance of stack gas desulfurization process.** Yanagioka, H. (Chiyoda Corp., Tokyo (Japan)). 20 Jan 1993. 94p. (In Japanese). In *Symposium on global environmental conservation and air pollution prevention technology.* Order Number DE93798681. Source: OSTI; NTIS (US Sales Only).

A stack gas desulfurization process in an oil and coal burning device removes SO2 from exhaust gases through absorption, but performs concomitantly secondary removal of solids in the gases, a dedusting function. This paper explains theoretical and design gists for the process noticing the above functions. Most frequently used gas-liquid contact mechanisms in wet type stack gas desulfurization equipment include a spray system, a filling column system, and a jet bubbling reactor (JBR) system. The JBR resembles the bubble cap tray, and has a function to collect solid particles accompanying bubble generation. Its collection efficiency has been published in the form of a theoretical equation for fully hydrophilic particles, which provides information on its relation with particle sizes and with equipment characteristics. However, this theory requires an attention that the equation hypothesizes that liquid containing particles can be separated completely from the gases, and the particles are fully hydrophilic. There are such other parts than the JBR as a prescrubber and a gas burning gas heater which can be expected of dedusting function. 4 refs., 7 figs.

25554 (OCDO–93013791) **Ammonia regeneration for a combined lime/ammonia spray dryer for SO_2 control: Final report.** Xinjian, Yang (Cincinnati Univ., OH (United States). Dept. of Civil and Environmental Engineering). Ohio Coal Development Office, Columbus, OH (United States); Cincinnati Univ., OH (United States). Dept. of Civil and Environmental Engineering. 23 Dec 1992. 170p. Sponsored by Ohio State Government, Columbus, OH (United States). Source: OSTI; Ohio Coal Development Office, 77 S. High Street, P.O. Box 1001, Columbus, OH 43266-0001.

A research project designed to study the feasibility of ammonia regeneration for a combined lime/ammonia FGD process was conducted at the University of Cincinnati. The major objective for this project was to regenerate ammonia from a combined ammonia/calcium hydroxide spray dryer FGD byproduct for reuse which would reduce the operating cost of this FGD process. This final report covers the six phases of the project: (1) generation of original feedstock, (2) batch regeneration studies, (3) continuous regeneration studies, (4) waste characteristic analysis, (5) pilot scale demonstration and (6) economic analysis. This research has shown that regeneration of ammonia is feasible at a reasonable cost. The effects on Ohio coal use from the results of this research could be substantial, depending on the Phase II application of FGD systems for controlling SO_2 emissions. In conclusion, experiments in this study have shown that ammonia recovery efficiencies greater than 90% are technically and economically feasible. In addition, the sludge produced from the regeneration process is stable and will meet existing Federal standards.

25555 (OCDO–93013794) **Design and development of a novel gas desulfurization process using hollow fiber membranes to stimulate the utilization of high sulfur Ohio coal: Final report.** LeBlanc, S.E.; Varanasi, S. Ohio Coal Development Office, Columbus, OH (United States); Toledo Univ., OH (United States). Dept. of Chemical Engineering. Jan 1990. 106p. Sponsored by Ohio State Government, Columbus, OH (United States). Source: OSTI; Ohio Coal Development Office, 77 S. High Street, P.O. Box 1001, Columbus, OH 43266-0001 (United States).

The objective of this proposed research was to carry out a detailed theoretical and experimental study of SO_2 absorption in bench-scale hollow fiber absorbers (HFAs) under conditions representative of industrial flue gas desulfurization, and to use this knowledge to develop design criteria necessary for replacing conventional packed towers with industrial scale HFAS. If the use of high sulfur coal is ever to come to fruition, we must strive to explore new technologies which surpass the performance of existing systems. The precise objectives of this research were as follows: Construct a benchscale HFA module apparatus for experimental testing. Investigate the effect of important process parameters on HFA module performance (i.e. its ability to remove SO_2). Obtain correlations for predicting the mass transfer coefficient (a direct reflection of module performance) for SO_2 removal based on the experimental results develop a mathematical model, design criteria,

and operating condition guidelines to produce optimum HFA module performance in desulfurization applications.

0109 Environmental Aspects

Refer also to citation(s) 25557, 25576, 25577, 26101, 26560, 27272, 27356, 27477, 27510

0120 Mining

25556 (DOE/EIA–0121(92/4Q)) **Energy Information Administration quarterly coal report, October–December 1992.** USDOE Energy Information Administration, Washington, DC (United States). Office of Coal, Nuclear, Electric and Alternate Fuels. 21 May 1993. 170p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93014500. Source: OSTI; NTIS; GPO; INIS; GPO Dep.

The United States produced just over 1 billion short tons of coal in 1992, 0.4 percent more than in 1991. Most of the 4-million-short-ton increase in coal production occurred west of the Mississippi River, where a record level of 408 million short tons of coal was produced. The amount of coal received by domestic consumers in 1992 totaled 887 miliion short tons. This was 7 million short tons more than in 1991, primarily due to increased coal demand from electric utilities. The average price of delivered coal to each sector declined by about 2 percent. Coal consumption in 1992 was 893 million short tons, only 1 percent higher than in 1991, due primarily to a 1-percent increase in consumption at electric utility plants. Consumer coal stocks at the end of 1992 were 163 million short tons, a decrease of 3 percent from the level at the end of 1991, and the lowest year-end level since 1989. US coal exports fell 6 percent from the 1991 level to 103 million short tons in 1992. Less coal was exported to markets in Europe, Asia, and South America, but coal exports to Canada increased 4 million short tons.

25557 (VF-UV–92-36) **Treatment of peat bogs harvested by deep digging technique: A literature study.** Hoernsten, L. (Swedish Univ. of Agricultural Sciences, Umeaa (Sweden). Dept. of Forest Ecology). Vattenfall AB, Vaellingby (Sweden). Jun 1992. 65 p.p. (In Swedish). Order Number DE93500669. Source: OSTI; NTIS; INIS.

Examination paper.

The aim of this study is to describe how peat bogs harvested by deep digging technique can be treated after harvesting has come to an end. The study points out treatment methods, how the treatments are carried out and to indicate the most appropriate method of harvest for optimum results. Costs and benefits are calculated for the methods involving cultivation. The knowledge gained from traditional peat harvesting technique indicate forestry, energy wood production and establishment of ponds as possible alternatives. Energy grass cultivation and establishments of game parks have not been tested. but are assumed to be viable on suitable sites. Establishment of duck ponds are also possible, even though conditions for these are better on firm ground. In this study spruce is estimated to produce 200 cubic meters during 105 year whilst pine produces 300 cubic meters. Calculations for pine and spruce estimate costs of respectively 17000 and 18000 SEK per hectare after 105 years. Energy wood production is estimated to be 11.6 tons dry matter per hectare and year which gives a net cost of 19000 SEK per hectare. Similarly energy grass cultivation results in an average annual harvest of 6.5 ton dry matter and a cost of 59000 SEK per hectare. If the results are applied to three specific cases, then forest cultivation and establishment of ponds are possible in all cases. Neither energy wood nor energy grass are appropriate in any of the three regions. At the particular site for this study all methods mentioned are possible. Depending on whether draining leads to a high or low water table, the most appropriate course would be the establishment of a pond respectively a game park of forest cultivation. (59 refs., 12 tabs., 4 figs.).

0130 Transport, Handling, and Storage

Refer also to citation(s) 25556

25558 (DOE/METC–92/6128-Vol.1, pp. 180-188) **Advanced research in instrumentaton and diagnostics technology.** Sheen, S.H. (Argonne National Laboratory, IL (US)); Lawrence, W.P. USDOE Morgantown Energy Technology Center, WV (United States). Sep 1992. (CONF-920951–Vol.1: 12. annual gasification and gas stream cleanup systems contractors review meeting, Morgantown, WV (United States), 15-17 Sep 1992). In *Proceedings of the twelfth annual gasification and gas stream cleanup systems contractors review meeting: Volume 1.* 325p. Order Number DE93000228. Source: OSTI; NTIS.

Major tasks of the project include (a) a feasibility study, (b) evaluation of sensing geometry and wedge design, (c) development of the image-reconstruction algorithm, and (d) flow tests of the imaging system. At present, we have completed the feasibility study and are evaluating wedge designs. Thus, only the feasibility study and a promising wedge design are described in this paper.

0140 Combustion

Refer also to citation(s) 25551, 25619, 26553

25559 (DOE/FTR–93012697) **Travel to Korea to attend the Eight US-Korea Joint Workshop on coal Utilization Technology and to conduct preliminary design review of the KIER Combustion Facility: Foreign trip report, August 16–28, 1992.** Smouse, S.M. USDOE, Washington, DC (United States). 21 Sep 1992. 22p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93012697. Source: OSTI; NTIS (US Sales Only); GPO Dep.

One of the collaborative-coal projects that is being conducted under the US Korea Memorandum of Understanding (MOU) is entitled "Pilot-Scale Coal Combustion Test Facility. The objective of this PETC/KIER project is the design and construction of a state-of-the-art pilot-scale pulverized-coal combustion facility at KIER's research center in Taejon, Korea, and the subsequent conduct of a collaborative pulverized-coal combustion research program. The design of the KIER facility is based largely on the existing PETC Fuels Evaluation Facility (FEF). 2. KIER's management required additional PETC support in the form of a critical-design review of the combustion facility. Subsequently, KIER extended an invitation to scott Smouse, the Project Leader for the FEF, to visit KIER during the late summer of 1992. Given their immediate needs, KIER also offered to bear all costs incurred during the trip. 3. Scott Smouse completed the critical-design review of KIER's new combustion facility and provided his comments to KIER's staff before his departure. Upon his return to PETC, he prepared a formal report, which was subsequently forwarded to KIER.

25560 (DOE/MC/26302–3269) **Stability of flows in fluidized beds: Final report.** Viscoustech, Allison Park, PA (United States). Apr 1993. 76p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC21-89MC26302. Order Number DE93000245. Source: OSTI; NTIS; GPO Dep.

We study the linearized stability of the state of uniform fluidization, within the context of the theory of mixtures. The mixture is assumed to be made up of a classical linearly viscous fluid mixed with solid particles. In marked departure from most of the previous studies, we model the solid as a granular material and assume a constitutive relation that stems from classical motions in continuum mechanics. The linearized stability analysis of the state of uniform fluidization, in general, leads to an eighth order equation for the characteristic whose root implies instability, when positive. We find that the characteristic equation can be factored and one of the factors is precisely the equation that governs the stability when we use a simplified analysis akin to that of the earlier study of Anderson and Jackson.

25561 (DOE/PC/79799–T17) **The Coal Tech Advanced Cyclone Combustor Demonstration Project: A DOE assessment.** USDOE Pittsburgh Energy Technology Center, PA (United States). May 1993. 54p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC22-87PC79799. Order Number DE93017043. Source: OSTI; NTIS; GPO Dep.

The objective of this project was to demonstrate a technology for retrofitting oil/gas designed boilers, and conventional pulverized

coal-fired boilers, by using the patented air-cooled slagging coal combustor in place of oil/gas/coal burners. The project aimed to utilize coals with a wide range of sulfur contents and to achieve efficient combustion under fuel-rich conditions. The three performance goals of the combustor were to limit emissions of SO_2 and NO_x, while maintaining maximum sulfur retention in the slag removed from the combustor. A slagging cyclone combustor is a high-temperature device in which a high-velocity swirling gas is used to burn crushed or pulverized coal. The key novel feature of this combustor is the use of air cooling. This is accomplished by using a ceramic liner which is cooled by secondary air and maintained at a temperature high enough to keep the slag in a liquid, free-flowing state. The arrangement also promotes slag retention in the combustor, an important feature for retrofitting in boilers designed for oil/gas.

25562 (DOE/PC/89776–T14) **Effects of calcium magnesium acetate on the combustion of coal-water slurries: Final project report, 1 September 1989–28 February 1993.** Levendis, Y.A.; Wise, D.; Metghalchi, H.; Cumper, J.; Atal, A.; Estrada, K.R.; Murphy, B.; Steciak, J.; Hottel, H.C.; Simons, G. Northeastern Univ., Boston, MA (United States). Dept. of Mechanical Engineering. 1993. 176p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-89PC89776 ;FG22-92PC92535. Grant CTS-8908652. Order Number DE93017029. Source: OSTI; NTIS; GPO Dep.

To conduct studies on the combustion of coal water fuels (CWFs) an appropriate facility was designed and constructed. The main components were (1) a high-temperature isothermal laminar flow furnace that facilitates observation of combustion events in its interior. The design of this system and its characterization are described in Chapter 1. (2) Apparatus for slurry droplet/agglomerate particle generation and introduction in the furnace. These devices are described in Chapters 1 and 3 and other attached publications. (3) An electronic optical pyrometer whose design, construction theory of operation, calibration and performance are presented in Chapter 2. (4) A multitude of other accessories, such as particle fluidization devices, a suction thermometer, a velocimeter, high speed photographic equipment, calibration devices for the pyrometer, etc., are described throughout this report. Results on the combustion of CWF droplets and CWF agglomerates made from micronized coal are described in Chapter 3. In the same chapter the combustion of CWF containing dissolved calcium magnesium acetate (CMA) axe described. The combustion behavior of predried CWF agglomerates of pulverized grain coal is contrasted to that of agglomerates of micronized coal in Chapter 4. In the same chapter the combustion of agglomerates of carbon black and diesel soot is discussed as well. The effect of CMA on the combustion of the above materials is also discussed. Finally, the sulfur capture capability of CMA impregnated micronized and pulverized bituminous coals is examined in Chapter 5.

25563 (DOE/PC/90258–T3) **Characterization and supply of coal based fuels: Quarterly report, May 1, 1987–July 31, 1987.** Energy International, Inc., Pittsburgh, PA (United States). Sep 1987. 93p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-86PC90258. Order Number DE93016787. Source: OSTI; NTIS; GPO Dep.

Contract objectives are as follows: Develop fuel specifications to serve combustor requirements. Select coals having appropriate compositional and quality characteristics as well as an economically attractive reserve base. Provide quality assurance for both the parent coals and the fuel forms. Deliver premium coal-based fuels to combustor developers as needed for their contract work. During the third quarter of this contract (May 1 through July 31, 1987) the primary activities were involved with: Completion and submission for approval by the DOE of the topical report describing the market survey, the coal selection and the fuel specification methodologies used in carrying out Task 1. The determination of the washability of the first five coals selected in Task 1. Upgrading and improvement of the pilot wash circuit to improve both the product quality and yield. Initiation of a data base survey to select an appropriate coal for the Vortec contract; and continuation of the coal procurement, cleaning, fuel preparation and delivery activities.

25564 (DOE/PC/90258–T4) **Characterization and supply of coal based fuels: Quarterly report, August 1, 1987–October 31, 1987.** Energy International, Inc., Pittsburgh, PA (United States). Jan 1988. 80p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-86PC90258. Order Number DE93016786. Source: OSTI; NTIS; GPO Dep.

Contract objectives are as follows: Develop fuel specifications to serve combustor requirements; Select coals having appropriate compositional and quality characteristics as well as an economically attractive reserve base; Provide quality assurance for both the parent coals and the fuel forms; and deliver premium coal-based fuels to combustor developers as needed for their contract work. Progress is discussed.

25565 (DOE/PC/90258–T6) **[Characterization and supply of coal based fuels]: Quarterly technical report, February 1, 1988–April 30, 1988.** Energy International, Inc., Pittsburgh, PA (United States). [1988]. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-86PC90258. Order Number DE93016784. Source: OSTI; NTIS; GPO Dep.

Contract objectives are as follows: Develop fuel specifications to serve combustor requirements; Select coals having appropriate compositional and quality characteristics as well as an economically attractive reserve base; Provide quality assurance for both the parent coals and the fuel forms; and deliver premium coal-based fuels to combustor developers as needed for their contract work. Progress is described.

25566 (DOE/PC/90258–T7) **Characterization and supply of coal-based fuels: Quarterly technical report, May 1, 1988–July 31, 1988.** Energy International, Inc., Pittsburgh, PA (United States). [1988]. 22p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-86PC90258. Order Number DE93016783. Source: OSTI; NTIS; GPO Dep.

Contract objectives are as follows: Develop fuel specifications to serve combustor requirements; select coals having appropriate compositional and quality characteristics as well as an economically attractive reserve base; provide quality assurance for both the parent coals and the fuel forms; and deliver premium coal-based furls to combustor developers as needed for their contract work.

25567 (DOE/PC/90258–T8) **Characterization and supply of coal based fuels: Technical progress report, August 1–October 31, 1988.** Energy International, Inc., Pittsburgh, PA (United States). Dec 1988. 32p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-86PC90258. Order Number DE93016782. Source: OSTI; NTIS; GPO Dep.

Contract objectives are as follows: Develop fuel specifications to serve combustor requirements; Select coals having appropriate compositional and quality characteristics as well as an economically attractive reserve base; Provide quality assurance for both the parent coals and the fuel forms; and deliver premium coal-based fuels to combustor developers as needed for their contract work. This quarter, work continued on washability studies, deashing and coal delivery requirements.

25568 (DOE/PC/90258–T9) **Characterization and supply of coal-based fuels: Quarterly report, November 1, 1988–January 31, 1989.** Energy International, Inc., Pittsburgh, PA (United States). Mar 1989. 24p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-86PC90258. Order Number DE93016781. Source: OSTI; NTIS; GPO Dep.

Contract objectives are as follows: Develop fuel specifications to serve combustor requirements; Select coals having appropriate compositional and quality characteristics as well as an economically attractive reserve base; Provide quality assurance for both the parent coals and the fuel forms; and deliver premium coal-based fuels to combustor developers as needed for their contract work. Progress is described.

25569 (DOE/PC/90258–T10) **Characterization and supply of coal-based fuels: Quarterly report, February 1, 1989–April 30, 1989.** Energy International, Inc., Pittsburgh, PA (United States). Jun 1989. 30p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-86PC90258. Order Number DE93016780. Source: OSTI; NTIS; GPO Dep.

Contract objectives are as follows: Develop fuel specifications to serve combustor requirements. Select coals having appropriate compositional and quality characteristics as well as an economically attractive reserve base; Provide quality assurance for both the parent coals and the fuel forms; and deliver premium coal-based fuels to combustor developers as needed for their contract work. Progress is discussed, particulary in slurry fuel preparation and particle size distribution.

25570 (DOE/PC/90258–T11) **Characterization and supply of coal-based fuels: Quarterly report, May 1, 1989–July 31, 1989.** Energy International, Inc., Pittsburgh, PA (United States). Sep 1989. 22p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-86PC90258. Order Number DE93016779. Source: OSTI; NTIS; GPO Dep.

Contract objectives are as follows: Develop fuel specifications to serve combustor requirements; Select coals having appropriate compositional and quality characteristics as well as an economically attractive reserve base; Provide quality assurance for both the parent coals and the fuel forms; and deliver premium coal-based fuels to combustor developers as needed for their contract work. Progress is described.

25571 (DOE/PC/90751–T15-VOL.1) **Transformations of inorganic coal constituents in combustion systems: Volume 1, sections 1–5: Final report.** Helble, J.J. (ed.) (PSI Technology Co., Andover, MA (United States)); Srinivasachar, S.; Wilemski, G.; Boni, A.A.; Kang, Shin-Gyoo; Sarofim, A.F.; Graham, K.A.; Beer, J.M.; Pe. USDOE Pittsburgh Energy Technology Center, PA (United States); PSI Technology Co., Andover, MA (United States). Nov 1992. 566p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-86PC90751. Order Number DE93013076. Source: OSTI; NTIS; GPO Dep.

The inorganic constituents or ash contained in pulverized coal significantly increase the environmental and economic costs of coal utilization. For example, ash particles produced during combustion may deposit on heat transfer surfaces, decreasing heat transfer rates and increasing maintenance costs. The minimization of particulate emissions often requires the installation of cleanup devices such as electrostatic precipitators, also adding to the expense of coal utilization. Despite these costly problems, a comprehensive assessment of the ash formation and had never been attempted. At the start of this program, it was hypothesized that ash deposition and ash particle emissions both depended upon the size and chemical composition of individual ash particles. Questions such as: What determines the size of individual ash particles? What determines their composition? Whether or not particles deposit? How combustion conditions, including reactor size, affect these processes? remained to be answered. In this 6-year multidisciplinary study, these issues were addressed in detail. The ambitious overall goal was the development of a comprehensive model to predict the size and chemical composition distributions of ash produced during pulverized coal combustion. Results are described.

25572 (DOE/PC/90751–T15-VOL.2) **Transformations of inorganic coal constituents in combustion systems: Volume 2, Sections 6 and 7: Final report.** Helble, J.J. (ed.) (PSI Technology Co., Andover, MA (United States)); Srinivasachar, S.; Wilemski, G.; Boni, A.A.; Kang, Shin-Gyoo; Sarofim, A.F.; Graham, K.A.; Beer, J.M.; Pe. USDOE Pittsburgh Energy Technology Center, PA (United States); PSI Technology Co., Andover, MA (United States). Nov 1992. 535p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-86PC90751. Order Number DE93013077. Source: OSTI; NTIS; GPO Dep.

Results from an experimental investigation of the mechanisms governing the ash aerosol size segregated composition resulting from the combustion of pulverized coal in a laboratory scale downflow combustor are described. The results of modeling activities used to interpret the results of the experiments conducted under his subtask are also described in this section. Although results from the entire program are included, Phase II studies which emphasized: (1) alkali behavior, including a study of the interrelationship between potassium vaporization and sodium vaporization; and (2) iron behavior, including an examination of the extent of iron-aluminosilicate interactions, are highlighted. Idealized combustion determination of ash particle formation and surface stickiness are also described.

25573 (DOE/PC/90751–T15-VOL.3) **Transformations of inorganic coal constituents in combustion systems: Volume 3, Appendices: Final report.** Helble, J.J. (ed.) (PSI Technology Co., Andover, MA (United States)); Srinivasachar, S.; Wilemski, G.; Boni, A.A.; Kang, Shim-Gyoo; Sarofim, A.F.; Graham, K.A.; Beer, J.M.; Pe. USDOE Pittsburgh Energy Technology Center, PA (United States); PSI Technology Co., Andover, MA (United States). Nov 1992. 457p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-86PC90751. Order Number DE93013078. Source: OSTI; NTIS; GPO Dep.

This report contains the computer codes developed for the coal combustion project. In Subsection B.1 the FORTRAN code developed for the percolative fragmentation model (or the discrete model, since a char is expressed as a collection of discrete elements in a discrete space) is presented. In Subsection B.2 the code for the continuum model (thus named because mineral inclusions are distributed in a continuum space) is presented. A stereological model code developed to obtain the pore size distribution from a two-dimensional data is presented in Subsection B.3.

25574 (DOE/PC/92152–T3) **The physics of coal liquid slurry atomization: Fourth Quarterly technical report, October 1, 1992–December 30, 1992.** Chigier, N.; Mansour, A. Carnegie-Mellon Univ., Pittsburgh, PA (United States). Dept. of Mechanical Engineering. [1992]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-92PC92152. Order Number DE93014949. Source: OSTI; NTIS; GPO Dep.

An experimental study has been conducted on a two dimensional twin fluid atomizer in which a liquid sheet is "sandwiched" between two sheets of high speed air. High speed photography and imaging were used to study the air-liquid interface region. Average intact lengths of liquid sheets were measured. The intact lengths were studied over a liquid Reynolds number range of 4000 and a Weber number of 30. The intact lengths were found to be strongly dependent on the Reynolds and Weber numbers. An empirical equation was derived as a function of these parameters.

25575 (ETDE/JP-mf–93798681, pp. 14-23) **Control of NOx and SOx generation in fluidized bed coal combustion, and N2O generation and its control.** Kimura, N. (Electric Power Development Co. Ltd., Tokyo (Japan)). 20 Jan 1993. 94p. (In Japanese). In *Symposium on global environmental conservation and air pollution prevention technology.* Order Number DE93798681. Source: OSTI; NTIS (US Sales Only).

With a purpose of establishing a technology for fluidized bed coal combustion, operation of a demonstration plant, a 50-MW fluidized bed boiler at the Wakamatsu thermal power plant has been continued since 1986. This paper reports the result of demonstration tests using nine kinds of overseas coals as to the NOx, SOx and N2O generation behaviors of the coals as well as the measures to reduce the generation. The test result showed the boiler's main combustion furnace having a combustion efficiency of 85% or higher, especially with high-volatility coals, a 99% or higher efficiency being very little affected from bed temperatures and air ratios in the bed. NOx generation increased with increasing combustion temperature, and the degree of temperature dependence varied largely by coal types. While SOx generation can be controlled by the amount of charged limestone, too low air ratio is not recommended. An optimum temperature exists. Such data on N2O being a global warming gas were obtained as influence of bed temperatures, use of higher exhaust gas temperatures as an exhaust gas generation preventive technology, free electron impinging treatment, and use of new catalysts. 14 figs., 3 tabs.

25576 (ETDE/JP-mf–93798681, pp. 30-34) **Semi-dry type dimplified desulfurizer.** Uemura, F. (Kawasaki Heavy Industries, Ltd., Tokyo (Japan)). 20 Jan 1993. 94p. (In Japanese). In *Symposium on global environmental conservation and air pollution prevention technology.* Order Number DE93798681. Source: OSTI; NTIS (US Sales Only).

Various types of stack gas desulfurization systems are available to remove sulfur from combustion gases generated in coal burning

boilers. This paper explains a semi-dry type desulfurizer suitable for developing countries because of its low construction and operating costs, easy operation and simple maintenance requirements. As an installation example, the paper shows using a system chart the configuration of a semi-dry type desulfurizer (for coal burning stoker boiler power generation consuming 32-T/H of coal and outputting 6-MW power) being installed under a Japanese Government's project of promoting research cooperation for Indonesia. The semi-dry type desulfurization process is a system to absorb SO2 in exhaust gases utilizing gas-liquid contact, which completes a desulfurization process at temperatures below the saturation temperature, and discharges no waste water outside the system. Major basic processes include an in-furnace desulfurization + water spray system, a dust injection system, and a spray dryer system. The in-furnace desulfurization system is of a two-step system consisting of a primary desulfurization to blow limestone powder into a boiler to remove sulfur and a process to spray water into exhaust gases downstream the boiler to cool the gases and remove sulfur. 5 figs., 1 tab.

25577 (ETSU-B–1313-P3) **An emissions audit of a chain grate stoker burning coal.** Jackson, P.M.; King, P.G. Warren Spring Lab., Stevenage (United Kingdom). 1993. 101p. (WSL-CR–3529(MR)). Order Number DE93504811. Source: OSTI; NTIS (US Sales Only); INIS.

This report describes the Emissions Audit carried out on a chain-grate stoker boiler burning coal. The boiler rated at 4.6MW(th) was installed at the Senior Foster Wheeler test facility in Wakefield where it had been modified so that it could burn both coal and dRDF. This report is based on test work undertaken as part of a programme to assess the environmental impact of the combustion of a variety of wastes as fuels. Emissions monitoring tests were carried out using coal as the fuel for comparison with the other wastes. Combustion of coal in boilers of this size are regulated by the Clean Air Acts whilst combustion of wastes is regulated by the more recent Environmental Protection Act. (author)

25578 (NEI-DK–1183) **The Technical University of Denmark/DIA cogeneration plant. Network measurements of temperature and gas concentrations in the combustion chamber: Measurements carried out in April - May 1991.** Johansen, L.P. Dk-TEKNIK, Soeborg (Denmark). Energi og Miljoe. Nov 1991. 44p. (In Danish). Contract EM-1323/86-2. Order Number DE93500125. Source: OSTI; NTIS.

EFP-86.

Temperature and gas concentration were measured in the combustion chamber of the coal-dust fired boiler at the cogeneration plant at the Technical University of Denmark. The aim was to determine the concentration of oxygen, carbon monoxide, sulfur dioxide, carbon dioxide and nitrogen monoxide after the coal-dust burner had been modified, as a basis for an evaluation of the influence of this modification on nitrogen monoxide emission. All the measurement results, some of which are shown three-dimensionally as curves running vertically through the boiler, are presented in detail. (AB).

0150 Economic, Industrial, and Business Aspects

Refer also to citation(s) 25556, 26471

0160 Health and Safety

Refer also to citation(s) 25978

25579 (DOE/METC–92/6128-Vol.2, pp. 571-582) **Toxicity studies of mild gasification products.** Ong, Tong-man (National Institute of Occupational Safety and Health, Morgantown, WV (US)); Whong, Wen-zong; Ma, J.; Zhong, Bao-zhen; Bryant, D. US-DOE Morgantown Energy Technology Center, WV (United States). Sep 1992. (CONF-920951–Vol.2: 12. annual gasification and gas stream cleanup systems contractors review meeting, Morgantown, WV (United States), 15-17 Sep 1992). In *Proceedings of the twelfth annual gasification and gas stream cleanup systems contractors review meeting: Volume 2.* 314p. Order Number DE93000229. Source: OSTI; NTIS.

The objectives of this project are: (1) to perform mutagenicity studies with the Ames Salmonella/microsomal assay system on coal liquids produced by mild gasification from different coals and/or processing conditions, (2) to determine whether coal liquids which are mutagenic to bacteria are also genotoxic to mammalian cells, (3) to establish correlations between mutagenicity, aromaticity, and boiling point range of coal liquids, and (4) to identify the chemical classes which are likely to be responsible for the mutagenic activity of gasification products.

02 PETROLEUM

0202 Reserves, Geology, and Exploration

Refer also to citation(s) 25584, 25586, 25587, 25591, 25593, 25594, 25595, 27662

25580 (DOE/BC/14425–T11) **Geologic setting, petrophysical characteristics, and regional heterogeneity patterns of the Smackover in southwest Alabama: Draft topical report on Subtasks 2 and 3.** Kopaska-Merkel, D.C.; Mann, S.D.; Tew, B.H. Alabama Geological Survey, Tuscaloosa, AL (United States). Jun 1992. 213p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-89BC14425. Order Number DE93014664. Source: OSTI; NTIS; GPO Dep.

This is the draft topical report on Subtasks 2 and 3 of DOE contract number DE-FG22-89BC14425, entitled "Establishment of an oil and gas database for increased recovery and characterization of oil and gas carbonate reservoir heterogeneity." This volume constitutes the final report on Subtask 3, which had as its primary goal the geological modeling of reservoir heterogeneity in Smackover reservoirs of southwest Alabama. This goal was interpreted to include a thorough analysis of Smackover reservoirs, which was required for an understanding of Smackover reservoir heterogeneity. This report is divided into six sections (including this brief introduction). Section two, entitled "Geologic setting," presents a concise summary of Jurassic paleogeography, structural setting, and stratigraphy in southwest Alabama. This section also includes a brief review of sedimentologic characteristics and stratigraphic framework of the Smackover, and a summary of the diagenetic processes that strongly affected Smackover reservoirs in Alabama. Section three, entitled "Analytical methods," summarizes all non-routine aspects of the analytical procedures used in this project. The major topics are thin-section description, analysis of commercial porosity and permeability data, capillary-pressure analysis, and field characterization. "Smackover reservoir characteristics" are described in section four, which begins with a general summary of the petrographic characteristics of porous and permeable Smackover strata. This is followed by a more-detailed petrophysical description of Smackover reservoirs.

25581 (DOE/BC/14425–T13-App.1-Vol.3) **Establishment of an oil and gas database for increased recovery and characterization of oil and gas carbonate reservoir heterogeneity: Appendix 1, Volume 3.** Kopaska-Merkel, D.C.; Moore, H.E. Jr.; Mann, S.D.; Hall, D.R. Alabama Geological Survey, Tuscaloosa, AL (United States). Jun 1992. 204p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-89BC14425 Order Number DE93014668. Source: OSTI; NTIS; GPO Dep.

This volume contains maps, well logging, structural cross section, graph of production history, porosity vs. natural log permeability plots, detailed core log, paragenetic sequence, and reservoir characterization sheet for the following fields in southwest Alabama: North Smiths Church oil field; North Wallers Creek oil field; Northeast Barnett oil field; Northwest Range oil field; Pace Creek oil field; Palmers Crossroads oil field; Perdido oil field; Puss Cuss Creek oil field; Red Creek gas condensate field; Robinson Creek oil field; Silas oil field; Sizemore Creek gas condensate field; Smiths Church gas condensate field; South Burnt Corn Creek oil field; South Cold Creek oil field; South Vocation oil field; South Wild Fork Creek gas condensate field; South Womack Hill oil field; Southeast Chatom gas condensate field; Southwest Barrytown oil field; and Souwilpa Creek gas condensate field.

25582 (DOE/BC/14425–T13-App.I-Vol.2) **Establishment of an oil and gas database for increased recovery and characterization of oil and gas carbonate reservoir heterogeneity: Appendix 1, Volume 2.** Kopaska-Merkel, D.C.; Moore, H.E. Jr.; Mann, S.D.; Hall, D.R. Alabama Geological Survey, Tuscaloosa, AL (United States). Jun 1992. 221p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-89BC14425. Order Number DE93014667. Source: OSTI; NTIS; GPO Dep.

This volume contains maps, well logging correlated to porosity and permeability, structural cross section, graph of production history, porosity vs. natural log permeability plots, detailed core log, paragenetic sequence, and reservoir characterization sheet for the following fields in southwest Alabama: East Huxford oil field; Fanny Church oil field; Gin Creek oil field; Gulf Crest oil field; Hanberry Church oil field; Hatter's Pond oil field; Healing Springs gas condensate field; Huxford oil field; Little Escambia Creek oil field; Little River oil field; Little Rock gas condensate field; Lovetts Creek oil field; Melvin oil field; Mill Creek oil field; Mineola oil field; Movico oil field; and North Choctaw Ridge oil field.

25583 (DOE/BC/14475–12) **Geophysical and transport properties of reservoir rocks: Final report for task 4: Measurements and analysis of seismic properties.** Cook, N.G.W. California Univ., Berkeley, CA (United States). May 1993. 167p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-89BC14475. Order Number DE93000139. Source: OSTI; NTIS; GPO Dep.

The principal objective of research on the seismic properties of reservoir rocks is to develop a basic understanding of the effects of rock microstructure and its contained pore fluids on seismic velocities and attenuation. Ultimately, this knowledge would be used to extract reservoir properties information such as the porosity, permeability, clay content, fluid saturation, and fluid type from borehole, cross-borehole, and surface seismic measurements to improve the planning and control of oil and gas recovery. This thesis presents laboratory ultrasonic measurements for three granular materials and attempts to relate the microstructural properties and the properties of the pore fluids to P- and S-wave velocities and attenuation. These experimental results show that artificial porous materials with sintered grains and a sandstone with partially cemented grains exhibit complexities in P- and S-wave attenuation that cannot be adequately explained by existing micromechanical theories. It is likely that some of the complexity observed in the seismic attenuation is controlled by details of the rock microstructure, such as the grain contact area and grain shape, and by the arrangement of the grain packing. To examine these effects, a numerical method was developed for analyzing wave propagation in a grain packing. The method is based on a dynamic boundary integ.al equation and incorporates generalized stiffness boundary conditions between individual grains to account for viscous losses and grain contact scattering.

0203 Drilling and Production

Refer also to citation(s) 25581, 25582, 25583, 25612, 27217, 27667

25584 (DOE/BC–92/3) **Contracts for field projects and supporting research on enhanced oil recovery: Progress review No. 71, quarter ending June 30, 1992.** USDOE Bartlesville Project Office, OK (United States). Jun 1993. 138p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93000116. Source: OSTI; NTIS; GPO Dep.

Progress reports are presented for the following tasks: chemical flooding–supporting research; gas displacement–supporting research; thermal recovery–supporting research; geoscience technology; resource assessment technology; microbial technology; and novel technology. A list of available publication is also provided.

25585 (DOE/BC/14205–17) **Mechanism and environmental effects on MEOR induced by the alpha process: Final report.** Hiebert, F.K.; Zumberge, J.; Rouse, B.; Cowes, A.; Lake, L.W. Alpha Environmental Corp., Austin, TX (United States). Apr 1993. 114p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-88BC14205. Order Number DE93000133. Source: OSTI; NTIS; GPO Dep.

This project was an interdisciplinary investigation of the enhanced oil recovery effects of a commercial microbial enhanced oil recovery (MEOR) system. The purpose was to investigate in parallel laboratory and field studies the response of a portion of the Shannon Sandstone reservoir to two single-well treatments with a commercial MEOR system, to investigate basic bacteria/rock interactions, and to investigate mechanisms of oil release. The MEOR system consisted of a mixed culture of hydrocarbon-utilizing bacteria, inorganic nutrients, and other growth factors. Parallel field and laboratory investigations into the effect and mechanisms of the treatment were carried out by independent principal investigators. The Shannon Sandstone at the Naval Petroleum Reserve #3 (NPR #3), Teapot Dome Field, Wyoming, was the location of the pilot field treatment. The treated and adjacent observation wells showed production and microbiological perturbations that are attributed to the effects of treatment during the first four post-treatment months. Effects of treatment declined to background levels within four months of inoculation. No production response was recorded in control wells unaffected by microbial stimulation. Laboratory research resulted in descriptions of colonization patterns of hydrocarbon-utilizing bacteria in the reservoir rock environment. Core-flooding research utilizing various components of the MEOR system did not result in the isolation of an oilrelease mechanism or measure incremental oil recovery from cores at residual oil saturation to waterflood. Chemical analysis of pre- and post-treatment produced oil identified large organic acid molecules concentrated in the asphaltenic fraction of posttreatment oil, but not in the oil from untreated control wells. No significant changes were measured in the overall quality of the oil produced from MEOR treated wells.

25586 (DOE/BC/14425–T12) **Evaluation of enhanced recovery operations in Smackover fields of southwest Alabama: Draft topical report on Subtasks 5 and 6.** Hall, D.R. Alabama Geological Survey, Tuscaloosa, AL (United States). Jun 1992. 164p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-89BC14425. Order Number DE93014665. Source: OSTI; NTIS; GPO Dep.

This report contains detailed geologic and engineering information on enhanced-recovery techniques used in unitized Smackover fields in Alabama. The report also makes recommendations on the applicability of these enhanced-recovery techniques to fields that are not now undergoing enhanced recovery. Eleven Smackover fields in Alabama have been unitized. Three fields were unitized specifically to allow the drilling of a strategically placed well to recover uncontacted oil. Two fields in Alabama are undergoing waterflood projects. Five fields are undergoing gas-injection programs to increase the ultimate recovery of hydrocarbons. Silas and Choctaw Ridge fields were unitized but no enhanced-recovery operations have been implemented.

25587 (DOE/BC/14831–3) **Assist in the recovery of bypassed oil from reservoirs in the Gulf of Mexico: Quarterly report, January 1–March 30, 1993.** Schenewerk, P.A. Louisiana State Univ., Baton Rouge, LA (United States). Dept. of Petroleum Engineering. 30 Apr 1993. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-92BC14831. Order Number DE93014534. Source: OSTI; NTIS; GPO Dep.

The objective of this research is to assist the recovery of non contacted oil from known reservoirs on the Outer Continental Shelf in the Gulf of,Mexico. Mature off shore reservoirs, declining oil reserves, declining production, and other natural forces are accelerating the abandonment of offshore oil resources and production platforms. As these offshore wells are plugged and the platforms are abandoned, an enormous volume of remaining oil will be permanently abandoned. Significant quantities of this oil could be recovered using advanced technologies now available if the resource can be identified. During this reporting period, ICF Resources Incorporated (ICF), a subcontractor for the project, continued to collect data from Minerals Management Service (MMS) and LSU continued to collect data from several operators. LSU also continued to modify BOAST II for the integration of radial grid systems and the building of the experimental apparatus for studying the recovery of attic oil. BDM Federal, Inc. (name changed from BDM International, Inc.) (BDM), a subcontractor for the project, began modifying the MASTER reservoir simulation model

for use in simulating miscible gas injection processes in steeply dipping reservoirs. LSU and BDM Federal. Inc. began analyzing data obtained from Taylor Energy in South Marsh 73 field.

25588 (DOE/FTR–93013086) **Travel to attend the International Energy Agency carbon dioxide symposium at Oxford, United Kingdom: Foreign trip report, March 27–April 3, 1993.** Bergman, P.D. USDOE Pittsburgh Energy Technology Center, PA (United States). 5 May 1993. 42p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93013086. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The author attended the International Energy Agency Carbon Dioxide Symposium held from March 29–April 1, 1993, at Oxford, United Kingdom and presented the paper "Availability of Depleted Oil and Gas Reservoirs for Disposal of Carbon Dioxide in the United States." The major conclusion of this meeting was that considerable progress has been made in establishing the technical feasibility of a diverse mix of robust site-specific CO_2 disposal options. The primary disposal options are subterranean disposal (abandoned oil and gas reservoirs and aquifers) and ocean disposal. Some other options of potential interest include enhanced oil recovery, the construction of dry ice spheres, and the use of aquatic biomass for CO_2 capture. The economic and ecological feasibility of these options remains to be proven. Bench-scale and pilot-scale experiments to test models and hypotheses should be emphasized at this early stage of development. However, a series of proof-of-concept experiments will have to eventually be performed. This entire effort should be carried out on an international basis as much as possible to reduce both the costs and risks associated with such experiments. In conclusion, there is no one, total, all-purpose, solution to the problem of end-of-pipe CO_2 sequestration. However, a series of site-specific solutions valid for the particular circumstances of individual countries appears to be attainable within a 5–20 year time frame.

25589 (DOE/ID/12842–2) **BOAST II for the IBM 3090 and RISC 6000: Final report.** Hebert, P.; Bourgoyne, A.T. Jr.; Tyler, J. Louisiana State Univ., Baton Rouge, LA (United States). May 1993. 150p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG07-89ID12842. Order Number DE93000138. Source: OSTI; NTIS; GPO Dep.

Includes 1 3-1/2 in. floppy disk.

BOAST II simulates isothermal, darcy flow in three dimensions. It assumes that reservoir liquids can be described in three fluid phases (oil, gas, and water) of constant composition, with physical properties that depend on pressure, only. These reservoir fluid approximations are acceptable for a large percentage of the world's oil and gas reservoirs. Consequently, BOAST II has a wide range of applicability. BOAST II can simulate oil and/or gas recovery by fluid expansion, displacement, gravity drainage, and capillary imbibition mechanisms. Typical field production problems that BOAST II can handle include primary depletion studies, pressure maintenance by water and/or gas injection, and evaluation of secondary recovery waterflooding and displacement operations. Technically, BOAST II is a finite, implicit pressure, explicit saturation (IMPES) numerical simulator. It applies both direct and iterative solution techniques for solving systems of algebraic equations. The well model allows specification of rate or pressure constraints on well performance, and the user is free to add or to recomplete wells during the simulation. In addition, the user can define multiple rock and PVT regions and can choose from three aquifer models. BOAST II also provides flexible initialization, a bubble-point tracking scheme, automatic time-step control, and a material balance check on solution stability. The user controls output, which includes a run summary and line-printer plots of fieldwide performance.

25590 (DOE/MC/27351–3335) **Mathematical modeling and simulation analysis of hydraulic fracture propagation in three-layered poro-elastic media.** Moon, H.Y. (Ohio State Univ., Columbus, OH (United States)); Advani, S.H.; Lee, T.S. Lehigh Univ., Bethlehem, PA (United States). Nov 1992. 278p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG21-90MC27351. Order Number DE93000272. Source: OSTI; NTIS; GPO Dep.

Hydraulic fracturing plays a pivotal role in the enhancement of oil and gas production recovery from low permeability reservoirs. The process of hydraulic fracturing entails the generation of a fracture by pumping fluids blended with special chemicals and proppants into the payzone at high injection rates and pressures to extend and wedge fractures. The mathematical modeling of hydraulically induced fractures generally incorporates coupling between the formation elasticity, fracture fluid flow, and fracture mechanics equations governing the formation structural responses, fluid pressure profile, and fracture growth. Two allied unsymmetric elliptic fracture models are developed for fracture configuration evolutions in three-layered rock formations. The first approach is based on a Lagrangian formulation incorporating pertinent energy components associated with the formation structural responses and fracture fluid flow. The second model is based on a generalized variational principle, introducing an energy rate related functional. These models initially simulate a penny-shaped fracture, which becomes elliptic if the crack tips encounters (upper and/or lower) barriers with differential reservoir properties (in situ stresses, 16 elastic moduli, and fracture toughness-contrasts and fluid leak-off characteristics). The energy rate component magnitudes are determined to interpret the governing hydraulic fracture mechanisms during fracture evolution. The variational principle is extended to study the phenomenon and consequences of fluid lag in fractures. Finally, parametric sensitivity and energy rate investigations to evaluate the roles of controllable hydraulic treatment variables and uncontrollable reservoir property characterization parameters are performed. The presented field applications demonstrate the overall capabilities of the developed models. These studies provide stimulation treatment guidelines for fracture configuration design, control, and optimization.

25591 (DOE/METC/C–93/7085) **Site evaluation criteria for a horizontal well in the Clinton Sandstone, Mahoning County, Ohio.** Mroz, T.H. (USDOE Morgantown Energy Technology Center, WV (United States)); Thomas, J.B.; Schuller, W.A. USDOE Morgantown Energy Technology Center, WV (United States). [1993]. 10p. Sponsored by USDOE, Washington, DC (United States). (CONF-9303178–1: 24. annual Appalachian petroleum geology symposium: innovative concepts in reservoir characterization, Morgantown, WV (United States), 29-31 Mar 1993). Order Number DE93015668. Source: OSTI; NTIS; GPO Dep.

A joint study between USDOE/METC and GRI was initiated to evaluate the application of horizontal wells for improving production from Clinton Sandstone reservoirs in eastern Ohio. A contract was awarded by USDOE/METC to Belden & Blake Inc. for drilling a horizontal well on their lease holdings in Mahoning Co., Ohio. Through a site evaluation study, reservoir and in situ stress characteristics were determined and well geometry designed. GRI contracted CER Corp. to drill a preliminary vertical well near the proposed horizontal well site to collect reservoir information and perform stress profile tests in the Clinton Sand reservoir and adjacent formations. USDOE and EG&G personnel worked with Belden and Blake, Inc. personnel to develop a 3-D geologic reservoir model. The geological model will be used as input parameters to reservoir simulation and production economic models to predict horizontal well effectiveness versus a conventional vertical well production at the selected site. This integrated effort is an example of the methodology that should be applied to the evaluation of a site prior to locating and designing a horizontal well. Realistically, an operator does not have the time nor money to drill a vertical well in an area for coring and stress testing the reservoir to determine natural fracture orientations and stress directions. Often these data can be obtained through published geologic literature on an area. However, natural and induced fracture orientations, reservoir properties (i.e. pressure, thickness, potential reserves) and the geologic environment are all key parameters for a successfully designed and oriented horizontal well.

25592 (LBL–33207) **Formation factor and the microscopic distribution of wetting phase in pore space of Berea sandstone.** Schlueter, E.M.; Myer, L.R.; Cook, N.G.W.; Witherspoon, P.A. Lawrence Berkeley Lab., CA (United States). Nov 1992. 23p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098 ;AC22-89BC14475. Order Number DE93015287. Source: OSTI; NTIS; GPO Dep.

Experimental studies have been accomplished aimed at studying the formation factor of a partially saturated rock. The effective formation factors to an electrolyte solution of the pore spaces not occupied by a wetting raid (paraffin wax) have been measured at various saturations, after solidifying the wetting fluid in place. The experimental data is studied in light of the role of the pore structure on the wetting fluid invasion process with the aid of fluid distributions at each saturation regime, a complete rock pore cast, and its associated rock section. The effect of clay minerals on formation factor is studied. The surface conductance contribution of day minerals to overall electrical conductivity is assessed. The effect of partial hydrocarbon saturation on overall rock conductivity and on the Archei saturation exponent is discussed.

25593 (NIPER–646) **Techniques for mapping the types, volumes, and distribution of clays in petroleum reservoirs and for determining their effects on oil production: Final report.** Sharma, B. National Inst. for Petroleum and Energy Research, Bartlesville, OK (United States). May 1993. 30p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC22-83FE60149. Order Number DE93000143. Source: OSTI; NTIS; GPO Dep.

This report presents the results of correlation of log signatures with information on distribution of the types and volumes of clays in sandstone pore spaces determined from detailed CT-scan, XRD, SEM, and thin section analyses of core samples from three sandstone reservoirs. The log signatures are then analyzed to determine if suitable mathematical/statistical parameter(s) could be calculated from the logs to determine their effects on permeability and oil production. The variability measures obtained from power spectral analysis of permeability and wireline log data in clayey formations have been correlated with oil production from two oil fields. Compared with the conventional measures of permeability variations like the Dykstra-Parsons coefficients, the new measure appears to correlate better with oil production.

25594 (NIPER–664) **[National Institute for Petroleum and Energy Research] 1991 annual report, October 1, 1990–September 30, 1991.** National Inst. for Petroleum and Energy Research, Bartlesville, OK (United States). May 1993. 76p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC22-83FE60149. Order Number DE93000137. Source: OSTI; NTIS; GPO Dep.

This Annual Report provides research accomplishments, publications, and presentations resulting from the FY91 research conducted under the following Base Program projects: reservoir assessment and characterization; TORIS research support; three-phase relative permeability; imaging techniques applied to the study of fluids in porous media; development of improved microbial flooding methods; development of improved surfactant flooding methods; development of improved alkaline flooding methods; development of improved mobility- control methods; gas flooding; mobility control and sweep improvement in gas flooding; thermal processes for light oil recovery; thermal processes for heavy oil recovery; thermochemistry and thermophysical properties of organic nitrogen- and diheteroatom- containing compounds; and development of analytical methodology for analysis of heavy crudes.

25595 (NIPER–684) **National Institute for Petroleum and Energy Research quarterly technical report, January 1–March 31, 1993: Volume 2, Energy production research.** National Inst. for Petroleum and Energy Research, Bartlesville, OK (United States). Jun 1993. 53p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC22-83FE60149. Order Number DE93015566. Source: OSTI; NTIS; GPO Dep.

Accomplishments for the past quarter are briefly described for the following tasks: chemical flooding – supporting research; gas displacement – supporting research; thermal recovery – supporting research; geoscience technology; resource assessment technology; and microbial technology. Chemical flooding covers: surfactant flooding methods; development of improved alkaline flooding methods; mobility control and sweep improvement in chemical flooding; and surfactant-enhanced alkaline flooding field project. Gas displacement covers: gas flooding performance prediction improvement; and mobility control, profile modification and sweep improvement in gas flooding. Thermal recovery includes: thermal processes for light oil recovery; thermal processes for heavy oil recovery; and feasibility study of heavy oil recovery in the mid-continent region – Oklahoma, Kansas, and Missouri; simulation analysis of steam-foam projects; and field application of foams for oil production symposium. Geoscience technology covers: three-phase relative permeability; and imaging techniques applied to the study of fluids in porous media. Resource assessment technology includes: reservoir assessment and characterization; TORIS research support; upgrade the BPO crude oil analysis data base; and compilation and analysis of outcrop data from the Muddy and Almond Formations. Microbial technology covers development of improved microbial flooding methods; and microbial-enhanced waterflooding field project.

25596 (NIPER–690) **National Institute for Petroleum and Energy Research monthly progress report, May 1993.** National Inst. for Petroleum and Energy Research, Bartlesville, OK (United States). Jun 1993. 67p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC22-83FE60149. Order Number DE93016005. Source: OSTI; NTIS; GPO Dep.

Accomplishments for the month of May are described briefly under tasks for: Energy Production Research; Fuels Research; and Supplemental Government Program. Energy Production Research includes: reservoir assessment and characterization; TORIS research support; development of improved microbial flooding methods; development of improved chemical flooding methods; development of improved alkaline flooding methods; mobility control and sweep improvement in chemical flooding; gas flood performance prediction improvement; mobility control, profile modification, and sweep improvement in gas flooding; three-phase relative permeability research; thermal processes for light oil recovery; thermal processes for heavy oil recovery; and imaging techniques applied to the study of fluids in porous media. Fuels Research covers: development of analytical methodology for analysis of heavy crudes; and thermochemistry and thermophysical properties of organic nitrogen- and diheteratom-containing compounds. Supplemental Government Program covers: microbial-enhanced waterflooding field project; feasibility study of heavy oil recovery in the midcontinent region–Oklahoma, Kansas, and Missouri; surfactant-enhanced alkaline flooding field project; process-engineering property measurements on heavy petroleum components; development and application of petroleum production technologies; upgrade BPO crude oil data base; simulation analysis of steam-foam projects; DOE education initiative project; field application of foams for oil production symposium; technology transfer to independent producers; compilation and analysis of outcrop data from the Muddy and Almond formations; implementation of oil and gas technology transfer initiative; horizontal well production from fractured reservoirs; and chemical EOR workshop.

25597 (SAND–93-0811C) **Observations of broad-band micro-seisms during reservoir stimulation.** Sleefe, G.E.; Warpinski, N.R.; Engler, B.P. Sandia National Labs., Albuquerque, NM (United States). [1993]. 4p. Sponsored by Gas Research Inst., Chicago, IL (United States). DOE Contract AC04-76DP00789. Contract 5089-211-2059. (CONF-930901–1: Annual meeting of the Society of Exploration Geophysicists, Washington, DC (United States), 26-30 Sep 1993). Order Number DE93011668. Source: OSTI; NTIS; GPO Dep.

During hydrocarbon reservoir stimulation such as hydraulic fracturing, the cracking and slippage of the formation results in the emission of seismic energy. The objective of this study was to determine the properties of these induced micro-seisms. A hydraulic fracture experiment was performed in the Piceance Basin of Western Colorado to induce and record micro-seismic events. The formation was subjected to four processes; breakdown/ballout, step-rate test, KCL mini-fracture, and linear-gel mini-fracture. Micro-seisms were acquired with an advanced three-component wall-locked seismic accelerometer package, placed in an observation well 211 ft offset from the well. During the two hours of formation treatment, more than 1200 micro-seisms with signal-to-noise ratios in excess of 20 dB were observed. The observed micro-seisms had a nominally flat frequency from 100 Hz to 1500 Hz and lack the spurious tool-resonance effects evident in previous

attempts to measure micro-seisms. Both p-wave and s-wave arrivals are clearly evident in the data set, and hodogram analysis yielded coherent estimates of the event locations. This paper describes the characteristics of the observed micro-seismic events (event occurrence, signal-to-noise ratios, and bandwidth) and illustrates that the new acquisition approach results in enhanced detectability and event location resolution.

0204 Processing

Refer also to citation(s) 25527, 25538

0207 Economic, Industrial, and Business Aspects

Refer also to citation(s) 26460, 26471

25598 (DOE/EIA–0340(92)/1) **Petroleum supply annual 1992: Volume 1.** USDOE Energy Information Administration, Washington, DC (United States). Office of Oil and Gas. 26 May 1993. 199p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93014712. Source: OSTI; NTIS; GPO; INIS; GPO Dep.

The Petroleum Supply Annual (PSA) contains information on the supply and disposition of crude oil and petroleum products. The publication reflects data that were collected from the petroleum industry during 1992 through annual and monthly surveys. The PSA is divided into two volumes. This first volume contains four sections: Summary Statistics, Detailed Statistics, Refinery Capacity and Oxygenate Capacity each with final annual data. The second volume contains final statistics for each month of 1992, and replaces data previously published in the Petroleum Supply Monthly (PSM). The tables in Volumes 1 and 2 are similarly numbered to facilitate comparison between them.

25599 (DOE/EIA–0340(92)/2) **Petroleum supply annual 1992: Volume 2.** USDOE Energy Information Administration, Washington, DC (United States). Office of Oil and Gas. 27 May 1993. 598p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93014713. Source: OSTI; NTIS; GPO; INIS; GPO Dep.

The Petroleum Supply Annual (PSA) contains information on the supply and disposition of crude oil and petroleum products. The publication reflects data that were collected from the petroleum industry during 1992 through annual and monthly surveys. The PSA is divided into two volumes. The first volume contains four sections: Summary Statistics, Detailed Statistics, Refinery Capacity, and Oxygenate Capacity each with final annual data. This second volume contains final statistics for each month of 1992, and replaces data previously published in the Petroleum Supply Monthly (PSM). The tables in Volumes 1 and 2 are similarly numbered to facilitate comparison between them. Explanatory Notes, located at the end of this publication, present information describing data collection, sources, estimation methodology, data quality control procedures, modifications to reporting requirements and interpretation of tables. Industry terminology and product definitions are listed alphabetically in the Glossary.

25600 (DOE/EIA–0380(93/05)) **Petroleum marketing monthly, May 1993.** USDOE Energy Information Administration, Washington, DC (United States). Office of Oil and Gas. 27 May 1993. 195p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93014659. Source: OSTI; NTIS; GPO; GPO Dep.

The Petroleum Marketing Monthly is designed to give information and statistical data about a variety of crude oils and refined petroleum products. The publication provides statistics on crude oil costs and refined petroleum products sales for use by industry, government, private sector analysts, educational institutions, and consumers. Data on crude oil include the domestic first purchase price, the f.o.b. and landed cost of imported crude oil, and the refiners' acquisition cost of crude oil. Sales data for motor gasoline, distillates, residuals, aviation fuels, kerosene, and propane are presented.

25601 (DOE/EIA–0520(93/05)) **International petroleum statistics report, May 1993.** USDOE Energy Information Administration, Washington, DC (United States). Office of Energy Markets and End Use. 1 Jun 1993. 67p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93015207. Source: OSTI; NTIS; GPO Dep.

The International Petroleum Statistics Report presents data on international oil production, demand, imports, exports, and stocks. The report has four sections. Section 1 contains time series data on world oil production, and on oil demand and stocks in the Organization for Economic Cooperation and Development (OECD). This section contains annual data beginning in 1980, and monthly data for the most recent two years. Section 2 presents an oil supply/demand balance for world. This balance is presented in quarterly intervals for the most recent two years. Section 3 presents data on oil imports by OECD countries. This section contains annual data for the most recent year, quarterly data for the most recent two quarters, and monthly data for the most recent twelve months. Section 4 presents annual time series data on world oil production and oil stocks, demand, and trade for the years 1970 through 1992; OECD stocks from 1973 through 1992; and OECD trade from 1982 through 1992.

25602 (DOE/EIA–0538(92/93-27)) **Winter fuels report week ending, April 16, 1993.** USDOE Energy Information Administration, Washington, DC (United States). Office of Oil and Gas. 22 Apr 1993. 81p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93012095. Source: OSTI; NTIS; GPO Dep.

The Winter Fuels Report is intended to provide concise, timely information to the industry, the press, policymakers, consumers, analysts, and State and local governments on the following topics: Distillate fuel oil net production, imports and stocks on a US level and for all Petroleum Administration for Defense Districts (PADD) and product supplied on a US level; propane net production, imports and stocks on a US level and for PADD's I, II, and III; natural gas supply and disposition and underground storage for the US and consumption for all PADD'S; as well as selected National average prices. Residential and wholesale pricing data for heating oil and propane for those States participating in the joint Energy Information Administration (EIA)/State Heating Oil and Propane Program; crude oil and petroleum price comparisons for the US and selected cities; and a 6–10 Day, 30-Day, and 90-Day outlook for temperature and precipitation and US total heating degree-days by city.

25603 (DOE/EIA–0538(92/93-29)) **Winter fuels report, week ending April 30, 1993.** USDOE Energy Information Administration, Washington, DC (United States). Office of Oil and Gas. 6 May 1993. 70p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93012826. Source: OSTI; NTIS; GPO Dep.

The Winter Fuels Report is intended to provide concise, timely information to the industry, the press, policymakers, consumers, analysts, and State and local governments on the following topics: distillate fuel oil net production, imports and stocks on a US level and for afl Petroleum Administration for Defense Districts (PADD) and product supplied on a US level; propane net production, imports and stocks on a US level and for PADD's I, II, and III; natural gas supply and disposition and underground storage for the US and consumption for all PADD's; as well as selected National average prices. Residential and wholesale pricing data for heating oil and propane for those States participating in the joint Energy Information Administration (EIA)/State Heating Oil and Propane Program; crude oil and petroleum price comparisons for the US and selected cities; and a 6–10 Day, 30-Day, and 90-Day outlook for temperature and precipitation and US total heating degree-days by city.

25604 (DOE/ID/01570–T164) **Alaska North Slope National Energy Strategy initiative: Analysis of five undeveloped fields.** Thomas, C.P.; Allaire, R.B.; Doughty, T.C.; Faulder, D.D.; Irving, J.S.; Jamison, H.C.; White, G.J. EG and G Idaho, Inc., Idaho Falls, ID (United States). May 1993. 348p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. Order Number DE93000142. Source: OSTI; NTIS; INIS; GPO Dep.

The US Department of Energy was directed in the National Energy Strategy to establish a federal interagency task force to identify specific technical and regulatory barriers to the development of five undeveloped North Slope Alaska fields and make

recommendations for their resolution. The five fields are West Sak, Point Thomson, Gwydyr Bay, Seal Island/Northstar, and Sandpiper Island. Analysis of environmental, regulatory, technical, and economic information, and data relating to the development potential of the five fields leads to the following conclusions: Development of the five fields would result in an estimated total of 1,055 million barrels of oil and 4.4 trillion cubic feet of natural gas and total investment of $9.4 billion in 1992 dollars. It appears that all five of the fields will remain economically marginal developments unless there is significant improvement in world oil prices. Costs of regulatory compliance and mitigation, and costs to reduce or maintain environmental impacts at acceptable levels influence project investments and operating costs and must be considered in the development decision making process. The development of three of the fields (West Sak, Point Thomson, and Gwydyr Bay) that are marginally feasible would have an impact on North Slope production over the period from about 2000 to 2014 but cannot replace the decline in Prudhoe Bay Unit production or maintain the operation of the Trans-Alaska Pipeline System (TAPS) beyond about 2014 with the assumption that the TAPS will shut down when production declines to the range of 400 to 200 thousand barrels of oil/day. Recoverable reserves left in the ground in the currently producing fields and soon to be developed fields, Niakuk and Point McIntyre, would range from 1 billion to 500 million barrels of oil corresponding to the time period of 2008 to 2014 based on the TAPS shutdown assumption.

25605 (INIS-mf–13562) **Qatar's economy transition from oil based economy to gas based economy.** Sastry, G.R.N. Ministry of Energy and Industry, Doha (Qatar). 1993. [11p.] Order Number DE93631670. Source: OSTI; NTIS (US Sales Only); INIS.

The historical aspects of petroleum industry development in Qatar are reviewed. Evaluation of Qatar's oil and natural gas reserves and production capacities is outlined. Trends of petroleum, petrochemical and gas industry further development are discussed. (V.G.).

0208 Waste Management

Refer also to citation(s) 25553

0209 Environmental Aspects

Refer also to citation(s) 27404, 27447, 27489

25606 (SAND–93-0824C) **Application of EM holographic methods to borehole vertical electric source data to map a fuel oil spill.** Bartel, L.C. Sandia National Labs., Albuquerque, NM (United States). [1993]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-930901–3: Annual meeting of the Society of Exploration Geophysicists, Washington, DC (United States), 26-30 Sep 1993). Order Number DE93011666. Source: OSTI; NTIS; INIS; GPO Dep.

The multifrequency, multisource holographic method used in the analysis of seismic data is to extended electromagnetic (EM) data within the audio frequency range. The method is applied to the secondary magnetic fields produced by a borehole, vertical electric source (VES). The holographic method is a numerical reconstruction procedure based on the double focusing principle for both the source array and the receiver array. The approach used here is to Fourier transform the constructed image from frequency space to time space and set time equal to zero. The image is formed when the in-phase part (real part) is a maximum or the out-of-phase (imaginary part) is a minimum; i.e., the EM wave is phase coherent at its origination. In the application here the secondary magnetic fields are treated as scattered fields. In the numerical reconstruction, the seismic analog of the wave vector is used; i.e., the imaginary part of the actual wave vector is ignored. The multifrequency, multisource holographic method is applied to calculated model data and to actual field data acquired to map a diesel fuel oil spill.

25607 (UCRL-JC–110348) **Dynamic Underground Stripping Engineering Demonstration Project: Construction, operation and engineering results.** Siegel, W.H. (Lawrence Livermore National Lab., CA (US)); Buettner, H.M.; Udell, K.S. Lawrence Livermore National Lab., CA (United States). May 1992. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-920851–97: Spectrum '92: nuclear and hazardous waste management international topical meeting, Boise, ID (United States), 23-27 Aug 1992). Order Number DE93017180. Source: OSTI; NTIS; INIS; GPO Dep.

The Dynamic Underground Stripping Project demonstrates cost-effective, rapid cleanup of localized underground plumes, often the result of leaking underground storage tanks. The technique combines the complementary technologies of subsurface steam injection and electrical resistance heating. The engineering demonstration phase of this project was completed on a clean, uncontaminated site with well- characterized geology. The Clean Site is located in Livermore, California at the US Department of Energy's Sandia National Laboratory (SNL). The experience gained at the Clean Site will be applied to clean up an 8,000 to 12,000 gallon gasoline spill, approximately 500 yards to the northwest, at the Lawrence Livermore National Laboratory (LLNL).

0220 Transport, Handling, and Storage

Refer also to citation(s) 25598, 25599

25608 (SAND–93-0706C) **The effects of latex additions on centrifugally cast concrete for internal pipeline protection.** Buchheit, R.G. (Sandia National Labs., Albuquerque, NM (United States)); Hinkebein, T.E.; Hlava, P.F.; Melton, D.G. Sandia National Labs., Albuquerque, NM (United States). [1993]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9309150–5: 12. international corrosion congress, Houston, TX (United States), 19-24 Sep 1993). Order Number DE93016495. Source: OSTI; NTIS; GPO Dep.

Centrifugally-cast concrete liners applied to the interiors of plain steel pipe sections were tested for corrosion performance in brine solutions. An American Petroleum Institute (API) standard concrete, with and without additions of a styrene-butadiene copolymer latex, was subjected to simulated service and laboratory tests. Simulated service tests used a mechanically pumped test manifold containing sections of concrete-lined pipe. Linear polarization probes embedded at steel-concrete interfaces tracked corrosion rates of these samples as a function of exposure time. Laboratory tests used electrochemical impedance spectroscopy to study corrosion occurring at the steel-concrete interfaces. Electron probe microanalysis (EPMA) determined ingress and distribution of damaging species, such as Cl, in concrete liners periodically returned from the field. Observations of concrete-liner fabrication indicate that latex loading levels were difficult to control in the centrifugal-casting process. Overall, test results indicate that latex additions do not impart significant improvements to the performance of centrifugally cast liners and may even be detrimental. Corrosion at steel-concrete interfaces appears to be localized and the area fraction of corroding interfaces can be greater in latex-modified concretes than in API baseline material. EPMA shows higher interfacial Cl concentration in the latex-modified concretes than in the API standard due to rapid brine transport through cracks to the steel surface.

0230 Properties and Composition

Refer also to citation(s) 25596

0250 Combustion

Refer also to citation(s) 26553

03 NATURAL GAS

25609 (DOE/METC/C–93/7064) **Overview of the DOE/METC Natural Gas Program.** Layne, A.W. Department of Energy, Morgantown, WV (United States). Morgantown Energy Technology Center. [1993]. 21p. Sponsored by USDOE, Washington, DC (United States). (CONF-9301108–1: United States Geological

workshop on future of energy gases, Palo Alto, CA (United States), 30-31 Jan 1993). Order Number DE93013484. Source: OSTI; NTIS; GPO Dep.

The mission of the US Department of Energy's (DOE) natural gas program is to enhance the Nation's energy security, economic growth and efficiency, and environmental quality. This mission will be accomplished by removing barriers to the expanded use of domestic natural gas; development of economic and environmentally efficient, reliable natural gas supply, storage, transportation, and utilization technologies; and improving competition and technology transfer. The Morgantown Energy Technology Center (METC) supports the DOE Natural Gas mission through research, development, - and demonstration (RD&D), of natural gas supply and utilization technologies. Projects are structured to foster eventual industry commercialization of the technologies. METC's RD&D is integrated with projects and activities being sponsored by other funding organizations. Goals of METC's program include increasing user confidence in long term supply of natural gas and verification of adequate gas reserves; and development and commercialization of high efficiency, cost-effective extraction and utilization technologies. METC's program also includes gas utilization projects on advanced gas turbine systems, fuel cells, and on processes to convert natural gas to liquid products. METC's vision for the year 2010 is the following: Natural gas recovery and environmental technologies will insure a reliable US natural gas supply of at least 23 trillion cubic feet (Tcf) per year from both conventional and nonconventional resources; for the utility market, advanced turbine systems operating on natural gas have been demonstrated and are available commercially; fuel cells and small advanced combustion turbine systems supply a distributed power market with natural gas fueled devices in the 1 to 50 megawatt electrical (MWe) range while the 50 MWe size range are being commercialized in the large industrial and commercial cogeneration markets.

0302 Reserves, Geology, and Exploration

Refer also to citation(s) 25580, 25581, 25582

25610 (DOE/METC/C–93/7069) **Overview: Gas hydrate geology and geography.** Malone, R.D. USDOE Morgantown Energy Technology Center, WV (United States). [1993]. 9p. Sponsored by USDOE, Washington, DC (United States). (CONF-930687–2: International conference on natural gas hydrates, New Paltz, NY (United States), 20-24 Jun 1993). Order Number DE93014043. Source: OSTI; NTIS; GPO Dep.

Several geological factors which are directly responsible for the presence or absence of gas hydrates have been reviewed and are: tectonic position of the region; sedimentary environments; structural deformation; shale diapirism; hydrocarbon generation and migration; thermal regime in the hydrate formation zone (HFZ); pressure conditions; and hydrocarbon gas supply to the HFZ. Work on gas hydrate formation in the geological environment has made significant advances, but there is still much to be learned. Work is continuing in the deeper offshore areas through the Ocean Drilling Program, Government Agencies, and Industry. The pressure/temperature conditions necessary for formation has been identified for various compositions of natural gas through laboratory investigations and conditions for formation are being advanced through drilling in areas where gas hydrates exist.

25611 (DOE/METC/C–93/7070) **Hydrate characterization research overview.** Malone, R.D. USDOE Morgantown Energy Technology Center, WV (United States). [1993]. 7p. Sponsored by USDOE, Washington, DC (United States). (CONF-930687–1: International conference on natural gas hydrates, New Paltz, NY (United States), 20-24 Jun 1993). Order Number DE93014039. Source: OSTI; NTIS; GPO Dep.

Gas hydrate research has been focused primarily on the development of a basic understanding of hydrate formation and dissociation in the laboratory, as well as in the field. Laboratory research on gas hydrates characterized the physical system, which focused on creating methane hydrates samples, tetrahydrofuran (THF) hydrate samples, consolidated rock samples, frost base mixtures, water/ice-base mixtures, and water-base mixtures. Laboratory work produced measurements of sonic velocity and electrical resistivity of hydrates. As work progressed, areas, such as the Gulf of Mexico and the Guatemala Trench, where gas hydrates are likely to occur were identified, and specific high potential areas were targeted for detailed investigation. The testing of samples and recovered cores from such areas provided information for detection of hydrate formations in the natural environment. Natural gas hydrate samples have been tested for thermal properties, dissociation properties, fracture mechanics, and optical properties. Acoustical properties were investigated both in the laboratory and, as possible, in the field. Sonic velocity and electrical resistivity measurements will continue to be obtained. These activities have been undertaken in hydrate deposits on Alaska's North Slope, the Gulf of Mexico and the US East coast offshore, as well as other gas hydrate target areas.

0303 Drilling, Production, and Processing

Refer also to citation(s) 25510, 25581, 25582, 25590, 25597

25612 (DOE/MC/27351–3336) **Application of characteristic time concepts for hydraulic fracture configuration design, control, and optimization: Final report.** Advani, S.H. (Lehigh Univ., Bethlehem, PA (United States)); Lee, T.S.; Moon, H. Lehigh Univ., Bethlehem, PA (United States). Oct 1992. 74p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG21-90MC27351. Order Number DE93000270. Source: OSTI; NTIS; GPO Dep.

The analysis of pertinent energy components or affiliated characteristic times for hydraulic stimulation processes serves as an effective tool for fracture configuration designs optimization, and control. This evaluation, in conjunction with parametric sensitivity studies, provides a rational base for quantifying dominant process mechanisms and the roles of specified reservoir properties relative to controllable hydraulic fracture variables for a wide spectrum of treatment scenarios. Results are detailed for the following multitask effort: (a) Application of characteristic time concept and parametric sensitivity studies for specialized fracture geometries (rectangular, penny-shaped, elliptical) and three-layered elliptic crack models (in situ stress, elastic moduli, and fracture toughness contrasts). (b) Incorporation of leak-off effects for models investigated in (a). (c) Simulation of generalized hydraulic fracture models and investigation of the role of controllable vaxiables and uncontrollable system properties. (d) Development of guidelines for hydraulic fracture design and optimization.

25613 (DOE/METC/C–93/7068) **Upgrading of raw natural gas using high-performance polymer membranes.** Stern, S.A. (Syracuse Univ., NY (United States)); Meyer, H.S.; Venkataraman, V.K.; Shoemaker, H.D. USDOE Morgantown Energy Technology Center, WV (United States). [1993]. 7p. Sponsored by USDOE, Washington, DC (United States). (CONF-9305166–2: American Filtration Society seminar and expo annual meeting, Chicago, IL (United States), 3-6 May 1993). Order Number DE93014041. Source: OSTI; NTIS; GPO Dep.

The separation of CO_2 and H_2S from raw natural gas is essential for enhancing the heating value of the gas and for providing environmental safety during nation and use. Membrane separation processes are particularly useful for this application because they are inherently energy-efficient. Membrane processes also offer other important advantages, such as ease of scale-up due to module design, good space and weight efficiency and great flexibility in handling variations in the flow rate, pressure and composition of the raw natural gas streams. In a coordinated effort, the Gas Research Institute and the Department of Energy, Morgantown Energy Technology Center are funding an extensive study at Syracuse University on the relationships between the chemical structure of various polymers and their permeability to different gases. Based on criteria derived from this study, novel fluorine-containing polyimides that exhibit very high CO_2/CH_4, selectivities as well as significant H_2S/CH_4, selectivities were synthesized. These "dense" (homogeneous) membranes separated various mixtures of CO_2/CH_4, and $H_2S/CH_4/CO_2$ at 35°C (95°F) and at pressures up to 10 atm (147 psi). The results of these measurements agree well with computer simulations. The $C0_2$ content of CH_4/CO_2 mixtures containing as much as 40 mole percent $C0_2$ can be reduced with the

polyamide membranes to pipeline specifications ($\leq$ 2 mole percent CO_2). To reduce the H_2S content of $H_2S/CH_4/CO_2$ mixtures to pipeline specifications ($\leq$ 4 ppM H_2S), the membranes are best combined with conventional gas-absorption processes, such as a selective amine. Such "hybrid" processes for the upgrading of natural gas can be more economical than conventional gas-absorption processes alone.

25614 (SAND–93-7039) **Multi-Site Project seismic verification experiment and assessment of site suitability.** Middlebrook, M. (CER Corp., Las Vegas, NV (US)); Peterson, R.; Warpinski, N.; Engler, B.; Sleefe, G.; Cleary, M.; Wright, T.; Branagan, P. Sandia National Labs., Albuquerque, NM (United States); Gas Research Inst., Chicago, IL (United States); CER Corp., Las Vegas, NV (United States); Resources Engineering Systems, Inc., Cambridge, MA (United States). Feb 1993. 106p. Sponsored by Gas Research Inst., Chicago, IL (United States). DOE Contract AC04-76DP00789. (GRI–93/0050). Order Number DE93015631. Source: OSTI; NTIS; GPO Dep.

The Multi-Site Project (M-Site No. 1) has been proposed as a means of resolving the significant unknowns associated with measuring and modeling the dimensions of hydraulic fractures. The proposed project would be performed using three existing wellbores associated with the former DOE Multiwell Experiment (MWX), as well as new wellbores drilled on the same site. The site initially appeared attractive because of: (1) multiple thick, laterally-continuous sandstone units present in the upper Mesaverde Group; (2) comprehensive, existing data sets which resulted from the MWX project; (3) the availability of the MWX wellbores for continued research; and (4) existing infrastructure which would facilitate the implementation of the project. However, before proceeding with full-scale project development, a series of assessments were necessary to definitively determine the suitability of the site from various perspectives. These perspectives included: (1) evaluation of confining stresses of the sandstone units; (2) assessment of wellbore (cement and casing) integrity; and (3) capability of remotely detecting seismic signals during a mini-frac. The site suitability assessments performed involved the use of existing stress data from the MWX wells and the acquisition of new seismic and fracture treatment data collected during field operations conducted in September and October 1992. These assessments concluded that the mechanical wellbore conditions, background seismic noise, seismic signal attenuation, remote seismic signal detection, stress contrast and hydraulic fracture pressure response clearly show that the MWX site is suitable for future fracture diagnostics experimentation to be conducted by GRI and DOE.

0306 Economic, Industrial, and Business Aspects

Refer also to citation(s) 25602, 25603, 25604, 25605, 25618, 26471

25615 (DOE/EIA–0130(93/05)) **Natural gas monthly, May 1993.** USDOE Energy Information Administration, Washington, DC (United States). Office of Oil and Gas. 25 May 1993. 131p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93014382. Source: OSTI; NTIS; GPO; GPO Dep.

The Natural Gas Monthly (NGM) is prepared in the Data Operations Branch of the Reserves and Natural Gas Division, Office of Oil and Gas, Energy Information Administration (EIA), US Department of Energy (DOE). The NGM highlights activities, events, and analyses of interest to public and private sector organizations associated with the natural gas industry. Volume and price date are presented each month for natural gas production, distribution, consumption, and interstate pipeline activities. Producer-related activities and underground storage data are also reported. From time to time, the NGM features articles designed to assist readers in using and interpreting natural gas information.

25616 (INIS-mf–13563) **The natural gas resources and industrial development in Qatar.** Qatar General Petroleum Corporation, Doha (Qatar). Oct 1992. [33p.] (CONF-9210377–: 2. conference on industrial cooperation between Arab Gulf states and European community, Doha (Qatar), 25 Oct 1992). Order Number DE93631689. Source: OSTI; NTIS (US Sales Only); INIS.

The presentation highlights aspects of the historic and present role of natural gas in Qatar, the current and future stages of the North Field Gas development and its utilization prospects. (V.G.).

0308 Environmental Aspects

25617 (INIS-mf–13564) **Status of energy intensive industrial development and ecological aspects of State of Qatar.** Al-Emadi, Y. Ministry of Energy and Industry, Doha (Qatar). Dept. of Industrial Development. [1993]. [11p.] (CONF-9304173–: Energy management and environment, Pilzen (Czech Republic), 20 Apr 1993). Order Number DE93630838. Source: OSTI; NTIS (US Sales Only); INIS.

The existing oil reserves in Qatar are likely to be exhausted within 20-30 years, but Qatar is fortunate to have large natural gas reserves on which future industrial development will be based. This document briefly reviews the Qatar North Field Gas Project.

0310 Legislation and Regulations

25618 (ANL/EAIS/CP–79499) **State policies affecting natural gas consumption (Notice of inquiry issued on August 14, 1992): Summary of comments.** Lemon, R.; Kamphuis-Zatopa, W. Argonne National Lab., IL (United States). 25 Mar 1993. 59p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-930495–1: DOE/NARUC national conference on natural gas use: state regulation and market dynamics in the post-636/Energy Policy Act, Era, New Orleans, LA (United States), 26-28 Apr 1993). Order Number DE93012879. Source: OSTI; NTIS; INIS; GPO Dep.

On August 14, 1992, the United States Department of Energy issued a Request for Comments Concerning State Policies Affecting Natural Gas Consumption. This Notice of (NOI) noted the increasing significance of the role played by states and sought to gain better understanding of how state policies impact the gas industry. The general trend toward a. more competitive marketplace for natural gas, as well as recent regulatory and legislative changes at the Federal level, are driving State regulatory agencies to reevaluate how they regulate natural gas. State action is having a significant impact on the use of natural gas for generating electricity, as well as affecting the cost-effective trade-off between conservation expenditures and gas use. Additionally, fuel choice has an impact upon the environment and national energy security. In light of these dimensions, the Department of Energy initiated this study of State regulation. The goals of this NOI are: (1) help DOE better understand the impact of State policies on the efficient use of gas; (2) increase the awareness of the natural gas industry and Federal and State officials to the important role of State policies and regulations; (3) create an improved forum for dialogue on State and Federal natural gas issues; and, (4) develop a consensus on an analytical agenda that would be most helpful in addressing the regulatory challenges faced by the States. Ninety-seven parties filed comments, and of these ninety-seven, fifteen parties filed reply comments. Appendix One lists these parties. This report briefly syntheses the comments received. The goal is to assist parties to judging the extent of consensus on the problems posed and the remedies suggested, aid in identifying future analytical analyses, and assist parties in assessing differences in strategies and regulatory philosophies which shape these issues and their resolution.

0330 Properties and Composition

Refer also to citation(s) 25611

0340 Combustion

25619 (NEI-DK–1186) **Use of natural gas in a shaft furnace for led smelting.** Lundborg, B. (Sydkraft Konsult (Sweden)). Nordisk Gasteknisk Center, Hoersholm (Denmark). Mar 1992. 14p. (In Swedish). Order Number DE93500135. Source: OSTI; NTIS.

Boliden Bergsoee AB is a Swedish company specializing in refining and recycling of non-iron metals. In the actual process lead is recycled from lead-batteries by reduction in a shaft-furnace. The furnace is charged with a mixture of scrap-lead and coke. The

coke is to serve as energy supplement and also as reduction material. The aim of the project is to investigate and evaluate if it is possible to replace 50% or more of the coke in the furnace with natural gas. The benefits could among others be increased productivity, clean and efficient utilization and simplified preheating of air which all reduces the costs. (au).

04 OIL SHALES AND TAR SANDS

0409 Waste Management

25620 (UCRL-JC–110320-Pt.2) **Catalytic activity of oxidized (combusted) oil shale for removal of nitrogen oxides with ammonia as a reductant in combustion gas streams, Part 2.** Reynolds, J.G.; Taylor, R.W.; Morris, C.J. Lawrence Livermore National Lab., CA (United States). 4 Jan 1993. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-921142–8-Pt.2: Eastern oil shale symposium, Lexington, KY (United States), 13-15 Nov 1992). Order Number DE93012586. Source: OSTI; NTIS; GPO Dep.

Oxidized oil shale from the combustor in the LLNL Hot-Recycled-Solids (HRS) oil shale retorting process has been found to be a catalyst for removing nitrogen oxides from laboratory gas streams using NH_3 as a reductant. Oxidized Green River oil shale heated at 10°C/min in an $Ar/O_2/NO/NH_3$ mixture (~93%/6%/2000 ppM/4000 ppM) with a gas residence time of ~0.6 sec removed NO between 250 and 500°C, with maximum removal of 70% at ~400°C. Under isothermal conditions with the same gas mixture, the maximum NO removal was ~64%. When CO_2 was added to the gas mixture at ~8%, the NO removal dropped to ~50%. However, increasing the gas residence time to ~1.2 sec, increased NO removal to 63%. Nitrogen balances of these experiments suggest selective catalytic reduction of NO is occurring using NH_3 as the reductant. These results are not based on completely optimized process conditions, but indicate oxidized oil shale is an effective catalyst for NO removal from combustion gas streams using NH_3 as the reductant. Parameters calculated for implementing oxidized oil shale for NO_x remediation on the current HRS retort indicate an abatement device is practical to construct.

05 NUCLEAR FUELS

0501 Reserves, Exploration, and Mining

25621 (EGG-M–93095) **Mineral bioprocessing.** Torma, A.E. EG and G Idaho, Inc., Idaho Falls, ID (United States). [1993]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. (CONF-9303162–1: International conference and workshop on applications of biotechnology to the minerals industry, Adelaide (Australia), 22-23 Mar 1993). Order Number DE93013678. Source: OSTI; NTIS; GPO Dep.

In the last 25 years, the introduction of biotechnological methods in hydrometallurgy has created new opportunities and challenges for the mineral processing industry. This was especially true for the production of metal values from mining wastes and low-and-complex-grade mineral resources, which were considered economically not amenable for processing by conventional extraction methods. Using bio-assisted heap, dump and in-situ leaching technologies, copper and uranium extractions gained their first industrial applications. The precious metal industries were the next to adopt the bio-preoxidation technique in the extraction of gold from refractory sulfide-bearing ores and concentrates. A variety of other bioleaching opportunities exist for nickel, cobalt, cadmium and zinc sulfide leaching. Recently developed bioremediation methods and biosorption technologies have shown a good potential for industrial applications to remove trace heavy metal and radionuclide concentrations from contaminated soils, and mining and processing effluents.

0504 Feed Processing

Refer also to citation(s) 25718

25622 (INIS-mf–12758, pp. 307-311) **UO_2 microspheres obtainment through the internal gelation methods.** Sterba, M.E. (Comision Nacional de Energia Atomica, San Carlos de Bariloche (Argentina). Centro Atomico Bariloche); Gomez Constenla, A. Asociacion Argentina de Tecnologia Nuclear, Buenos Aires (Argentina). 1987. [735p.] (In Spanish). (CONF-8711355–: 15. scientific meeting and 4th Latin American meeting and 1st sessions on nuclear power plants, San Carlos de Bariloche (Argentina), 2-6 Nov 1987). In *Proceedings of the fifteenth scientific meeting; fourth Latin American meeting; first sessions on nuclear power plants.* Order Number DE91003052. Source: OSTI; NTIS (US Sales Only); INIS.

UO_2 microspheres obtainment process through the internal gelation method which allows the spheres' obtainment of uniform size is detailed herein, varying the same among 0.3 and 1.7 mm of diameter. The sintered density reaches 10.78 g/cm^3, permitting the fuels fabrication dispersed and vibro-compacted fuels. The trichloroethylene use implementation as gelation agent is described, thus reducing the number of stages in the microspheres fabrication. At the same time, the uranium sun composition has been modified so as to be compatible with the use solvent. (Author).

25623 (INIS-mf–12758, pp. 312-316) **Plutonium oxide obtainment from a plutonium fluoride.** Adelfang, P. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina). Dept. de Combustibles Nucleares); Esteban, A.; Orosco, E.H. Asociacion Argentina de Tecnologia Nuclear, Buenos Aires (Argentina). 1987. [735p.] (In Spanish). (CONF-8711355–: 15. scientific meeting and 4th Latin American meeting and 1st sessions on nuclear power plants, San Carlos de Bariloche (Argentina), 2-6 Nov 1987). In *Proceedings of the fifteenth scientific meeting; fourth Latin American meeting; first sessions on nuclear power plants.* Order Number DE91003052. Source: OSTI; NTIS (US Sales Only); INIS.

The need to recover the Pu existing in the Alpha Facility for the experimental fabrication of mixed oxides fuel elements $(U,Pu)O_2$, its recovery has been set up from the F_4Pu available at the laboratory. To fulfill the strict specifications on fluorides in nuclear fuels, it was necessary to precisely adjust the purification phase. This paper describes the chemical process for the PuO_2 obtainment from F_4Pu. F_4Pu was dissolved in nitric acid, adding aluminium nitrate. The concentration in the medium decreases due to the complexes formation with fluorides and this allows the full dissolution of the salt. Pu separation was carried out by the treatment with RESINE DOWEX in columns. After purification with successive washes in NO_3H_7M, Pu elution retained in the column was performed. Finally, it precipitated as Pu IV oxalate and PuO_2 was obtained by calcination at 700 deg C. (Author).

25624 (INIS-mf–12758, pp. 395-399) **Control of criticality risk in the manufacture of fuel elements for research reactors.** Friedenthal, M. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina). Dept. de Combustibles Nucleares); Cardenas Yucra, H.R.; Marajofsky, A.; La Gamma de Batistoni, A.M. Asociacion Argentina de Tecnologia Nuclear, Buenos Aires (Argentina). 1987. [735p.] (In Spanish). (CONF-8711355–: 15. scientific meeting and 4th Latin American meeting and 1st sessions on nuclear power plants, San Carlos de Bariloche (Argentina), 2-6 Nov 1987). In *Proceedings of the fifteenth scientific meeting; fourth Latin American meeting; first sessions on nuclear power plants.* Order Number DE91003052. Source: OSTI; NTIS (US Sales Only); INIS.

The control of criticality risk in a chemical plant adopts different forms according to the quantities of fissile material and the type of compounds used. This work presents the treatment of the critical excursion risk adopted in production plants of U_3O_8 and manufacturing plants of fuel elements for research reactors, located in Constituyentes Atomic Center. The possible events and accidents related to the fissile material control are analyzed, and the systems of administrative control and intrinsic safety through engineering are described. (Author).

25625 (IPEN-PUB–373) **Thermogravimetry for optimization of chloride pyro hydrolytic separations in zirconia-magnesia**

matrix. Pires, M.A.F.; Dantas, E.S.K. Instituto de Pesquisas Energeticas e Nucleares (IPEN), Sao Paulo, SP (Brazil). Aug 1992. [25p.] (In Portuguese). (CONF-9203266–: French-Brazilian Materials Sciences Symposium, Ouro Preto (Brazil), 16-21 Mar 1992). Order Number DE93629070. Source: OSTI; NTIS (US Sales Only); INIS.

A fast and accurate method for chloride ion determination in zirconia-magnesia matrix was studied the method consists in the pyro hydrolysis of the oxides at 900° C, using a quartz apparatus, during thirty minutes and further determination of the chloride ion collected by means of either ion-selective electrode or ion chromatography. The thermogravimetric curves (TG curves) of the metal oxides and oxychlorides provide all the information about the chloride ion evolution temperature and the influence of pyro hydrolytic accelerators ($U_3 O_8$) on ion evolution. (author).

25626 (KAERC–502/89) **Investigation of extractive separation of uranium and vanadium from sulphuric acid leaching liquors of uranium ore (1): Extractive property of HDEHP.** Han Hi Jong. Ministry of Atomic Energy, Pyongyang (Korea, Democratic People's Republic of). Research Center for Atomic Energy. Feb 1989. [6p.] (In Korean). Order Number DE93627689. Source: OSTI; NTIS (US Sales Only); INIS.

Condition of extractive separation of U and V from sulphuric acid leaching liquors of uranium ore by HDEHP was confirmed. For high selectivity of uranium extraction concentration of solvent, phase contact time and pH of aqueous solution must be decreased. To increase extractive capacity of vanadium, above indices have to be increased reversibly. Capacity of HDEHP for U is 80-100g/mol, for V 17-21g/mol. (Author).

25627 (KAERC–503/89) **Investigation of extractive separation of uranium and vanadium from sulphuric acid leaching liquors of uranium ore (2): Reduction of Fe(III) from sulphuric acid.** Han Hi Jong. Ministry of Atomic Energy, Pyongyang (Korea, Democratic People's Republic of). Research Center for Atomic Energy. Feb 1989. [9p.] (In Korean). Order Number DE93627690. Source: OSTI; NTIS (US Sales Only); INIS.

Reduction condition of Fe(III) to extract uranium and vanadium with HDEHP from sulphuric acid leaching liquors of uranium ore was examined. It was shown that in the system of oxidation-reduction consisted of many ionic pairs can reduce Fe(III) with iron scraps selectively and at this time factors affected on its reduction is hydro-ionic concentration in solution and diffusion factor. (Author).

25628 (KAERC–504/89) **Study of the influence of factors on the adsorption co-precipitation of the uranium with calcium hydroxide.** Li Goon Dae. Ministry of Atomic Energy, Pyongyang (Korea, Democratic People's Republic of). Research Center for Atomic Energy. Feb 1989. [8p.] (In Korean). Order Number DE93627691. Source: OSTI; NTIS (US Sales Only); INIS.

By observing the influence of factors on the adsorption co-precipitation of the uranium with calcium hydroxide, a formula was obtained, by which uranium concentration is determined in the adsorption co-precipitation mother liquor. This relation allows us to predict uranium concentration in the adsorption co-precipitation mother liquor according to quantity of the co-precipitator and helps practical purifying. (Author).

25629 (KAERC–505/89) **Investigation of recovery of nickel from raffinate treated uranium ore.** Kim Song Soon; Baek Myong Goon; Kim Yong Taek. Ministry of Atomic Energy, Pyongyang (Korea, Democratic People's Republic of). Research Center for Atomic Energy. Feb 1989. [8p.] (In Korean). Order Number DE93627692. Source: OSTI; NTIS (US Sales Only); INIS.

Condition of separation and formation of ion $(Ni(NH_3)_n)^{2+}$ from raffinate treated uranium ore was confirmed experimently. Condition to convert nickel from raffinate into ammoniacal complex is as follows: pH 9.4-10. Concentration of all ammonia 2.18 M. When adsorbing complex with sulphonate cation exchanger, rate of recovery is over 95% in counter current 6 stage. (Author).

0505 Uranium Enrichment

Refer also to citation(s) 26328, 27224

25630 (CEA-CONF–11307) **Atomic vapor laser isotope separation in France.** Camarcat, N.; Lafon, A.; Perves, J.P.; Rosengard, A. CEA Centre d'Etudes de Saclay, 91 - Gif-sur-Yvette (France). Dept. des Procedes d'Enrichissement. 1992. [12p.] (CONF-9208222–: 3. International Workshop on Separation Phenomena in Liquids and Gases, Charlottesville, VA (United States), 18 Aug 1992). Order Number DE93630996. Source: OSTI; NTIS (US Sales Only); INIS.

The main effort in the field of Isotopic Separation Research and Development in France is devoted since 1985 to the 'SILVA' process. A structured organization has been set up, including the following elements: Specific Research and Development for all the functions and components of the process: this work is supported by numerous benches located in Saclay and Pierrelatte. Each bench is mainly devoted to one process function; regarding process and operating performances are optimized. Integrated Experiences in a Pilot facility. Qualified components are integrated in a pilot facility located in Saclay, the capacity of which is steadily increased. At each stage, complete separative experiments demonstrate the improvements attained. Focused Basic Research for each field, often linked with various and relatively original phenomenas. Models have been built up, supported by specific experiments and values attained for intrinsical parameters. An aggregated process performance computing code integrates all the models, possibly under simplified form. Technical, operating and economical data are gradually added. A general assessment will take place in the middle of the nineties with several technical demonstrations and a complete evaluation of the French AVLIS process.

25631 (INIS-mf–12758, pp. 400-407) **Inventory control through gamma spectrometry at the enriched uranium laboratory.** Vicens, H.E. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina). Gerencia de Procesos Quimicos); Korob, R.O.; Goldschmidt, A.E. Asociacion Argentina de Tecnologia Nuclear, Buenos Aires (Argentina). 1987. [735p.] (In Spanish). (CONF-8711355–: 15. scientific meeting and 4th Latin American meeting and 1st sessions on nuclear power plants, San Carlos de Bariloche (Argentina), 2-6 Nov 1987). In *Proceedings of the fifteenth scientific meeting; fourth Latin American meeting; first sessions on nuclear power plants.* Order Number DE91003052. Source: OSTI; NTIS (US Sales Only); INIS.

The enriched uranium laboratory processes alternatively uranium 90% and 20% enriched in U-235. The control of the isotopic composition of lots is made through mass spectrometry. In the laboratory operation wastes of both enrichments are generated and the recovery is performed with a time delay. To strengthen the administrative controls, avoid errors related to personnel replacement and/or deferred operations, it seemed suitable to adjust the gamma spectrometry as a fast, simple and available method to determine the enrichment. The laboratory work includes a wet and a dry process. The waste recovery necessarily involves the handling of liquid samples. For this reason, it was decided to determine the calibration curve for uranyl nitrate samples of fixed concentration and geometry. The samples were prepared from material purified through double precipitation of uranium peroxide and subsequent ignition to $U_3 O_8$ in platinum crucible, in tubular oven during 8 hours at 720 deg C. The preparation of samples, the measurement description, the discussion of results and the analysis of errors due to the presence of insoluble material and concentration changes are included. (Author).

25632 (ORNL/TM–12234) **Switchover software reliability estimate for Paducah Freezer/Sublimer computer systems.** Flanagan, D.M.; Davis, J.N. Oak Ridge National Lab., TN (United States). Apr 1993. 74p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93013844. Source: OSTI; NTIS; GPO Dep.

K-25 Engineering Division purchased a series of redundant computer systems and developed software for the purpose of providing continuous process monitoring and control for the Freezer/Sublimer equipment in the gaseous diffusion process at the Paducah Gaseous Diffusion Plant. The application software is loaded on two central processing units (CPU) so that in the event of a failure of the primary unit, the processing can switch to the backup unit and

continue processing without error. It is the purpose of this document to demonstrate the reliability of this system with respect to its ability to switch properly between redundant CPU. The total reliability estimation problem – which considers the computer hardware, the operating system software, and the application software – has been reduced to one that considers only the application software directly involved in the switchover process. Estimates are provided for software reliability and the testing coverage. Software and hardware reliability models and reliability growth models are considered in addition to Bayesian approaches.

25633 (SR/H–563) **[The Hanford story, Chapter 14].** [Plant Histories]. Hanford Engineer Works, Richland, WA (United States). [1943]. 45p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. Order Number DE93014696. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document, Chapter 14 of "The Hanford Story" provides a discussion of the production of Uranium 235 and of the research, development, and design of the diffusion and centrifuge processes utilized in this production.

25634 (SR/H–564) **[The Hanford story, Chapter 15].** [Plant Histories]. Hanford Engineer Works, Richland, WA (United States). [1943]. 65p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. Order Number DE93014697. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document, Chapter 15 of "The Hanford Story" discusses the production of Uranium 235 and the construction and production of the Electromagnetic Process Plant at the Oak Ridge location.

25635 (SR/H–565) **[The Hanford story, Chapter 16].** [Plant Histories]. Hanford Engineer Works, Richland, WA (United States). [1945]. 48p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. Order Number DE93014698. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document, Chapter 16 of "The Hanford Story" discusses the production of Uranium 235 production and the construction and production of the Gaseous Diffusion Plant at the Oak Ridge Reservation.

0507 Fuels Production and Properties

Refer also to citation(s) 26200, 26207, 26220, 26282, 26283, 26284, 26285, 26286, 26287, 26288, 26289, 26291, 26292, 26293, 26296, 26297, 26298, 26313, 26314, 26328, 26737, 26753, 27250, 27255, 28088

25636 (CONF-9309120–2) **Measurements with an unreflected uranium (93.2%) metal sphere.** Mihalczo, J.T. (Oak Ridge National Lab., TN (United States)); Lynn, J.J.; Taylor, J.R.; Hansen, G.E. Oak Ridge National Lab., TN (United States). [1993]. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From American Nuclear Society meeting; Nashville, TN (United States); 19-23 Sep 1993. Order Number DE93013515. Source: OSTI; NTIS; GPO Dep.

A near spherical unreflected and unmoderate uranium (93.7) metal configuration had been assembled to delayed criticality at Los Alamos National Laboratory in the 1950's. Experiments with highly enriched uranium metal spherical shells had also been assembled. Both these experiments have been used to estimate the unreflected and unmoderated highly enriched uranium spherical critical mass. The experiments described in this paper, although originally justified for leakage spectra measurements and to investigate the use of a multiplying booster with a linear accelerator, also can provide estimates of the unreflected and unmoderated, highly enriched uranium spherical metal critical mass.

25637 (DPW–3665) **[Mechanical problems with Dana equipment at Savannah River].** Bloomsburg, M.S. Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). 31 Oct 1951. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. (SR/H–467). Order Number DE93011164. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This memorandum discusses various mechanical problems in connection with Dana equipment. The method of solution and disposition of the problems is also provided. (FL)

25638 (ENEA-RTI-PCM-IFEC–92-04) **Decommissioning of pilot fuel fabrication facility at Saluggia.** Guidotti, M.; Sberze, L. ENEA, Saluggia (Italy). Area Nucleare. Nov 1992. 9p. (CONF-9202136–1: Nuclear DECOM '92: decommissioning of radioactive facilities international conference, London (United Kingdom), 17-19 Feb 1992). Order Number DE93799231. Source: OSTI; NTIS (US Sales Only); INIS.

Following Italy's decision to close down the nuclear power stations existing in the country, ENEA (Italian Agency for Energy, New Technologies and the Environment) has started decommissioning its facilities relevant to the fuel cycle. The first facility to be decommissioned was the Fuel Fabrication Pilot Plant (IFEC) situated at the Saluggia Centre. The IFEC Plant comprised a store, three lines respectively for MTR CIRENE (Candu type) and enriched UO_2 fuel fabrication, and various auxiliary facilities (quality control laboratories, ventilation, etc.). Decommissioning has consisted in the transfer of all fissile material, in the decontamination to background levels of most of the equipment and of the whole building and in the dismantling of the equipment that could not be completely decontaminated. The scope of the operation was: to recover, for normal use, the building and most of the equipment of the plant; and to minimize the quantity and volume of the wastes produced. The decommissioning operations have been authorized by the competent authority, where necessary, and have been carried out mostly by the personnel that had previously operated the plant.

25639 (HW–18712) **P-10 air monitor design criteria.** Eisenacher, P.L. Hanford Works, Richland, WA (United States). 29 Aug 1950. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93017351. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This HAPO report documents the design criteria for the P-10 air monitor at the 300 Area. Minimum reliable readings and accompanying remarks document testing of four different monitors.

25640 (IAEA-TECDOC–697, pp. 82-87) **FP gas release behaviour of high burn-up MOX fuels for thermal reactors.** Kamimura, K. (Power Reactor and Nuclear Fuel Development Corp., Toakai, Ibaraki (Japan)). International Atomic Energy Agency, Vienna (Austria). Apr 1993. (CONF-9204252–: Technical committee meeting on fission gas release and fuel rod chemistry related to extended burnup, Pembroke (Canada), 28 Apr - 1 may 1992). In *Fission gas release and fuel rod chemistry related to extended burnup: Proceedings of a technical committee meeting held in Pembroke, Ontario, Canada, 28 April - 1 May 1992.* [235p.] Order Number DE93628297. Source: OSTI; NTIS (US Sales Only); INIS.

Instrumented rig IFA-565 is now under irradiation in HBWR to investigate high burn-up MOX fuel behaviour for thermal reactors. The irradiation test of IFA-514 (former rig number for IFA-565) was performed from 1979 to 1988. The fission gas release behaviour for the MOX fuel rods of IFA-514/565 to the burn-up level of 41GWd/t MOX (47GWd/tM) has been analysed. The following observations are made: Vitanza threshold for UO_2 fuel is applicable to predict the onset of fission gas release for MOX fuel; There were no significant differences in fission gas release fraction between PNC MOX fuels and UO_2 fuels at about 47GWd/tM; Fission gas release fraction of hollow pellets might be smaller than that of solid pellets according to the In-pile data. It is necessary to confirm the result by using PIE data after the irradiation; PNC MOX fuels have achieved high burn-up as 47GWd/tM without failure. (author). 7 refs, 7 figs, 2 tabs.

25641 (LA-UR–93-1860) **Safeguards instrumentation for continuous unattended monitoring in plutonium fuel fabrication plants.** Menlove, H.O. (Los Alamos National Lab., NM (United States)); Miller, M.C.; Ohtani, T.; Seya, M.; Takahashi, S. Los Alamos National Lab., NM (United States). [1993]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9309151–2: Global '93: international conference and technology exhibition, Seattle, WA (United States), 12-17 Sep 1993). Order Number DE93014480. Source: OSTI; NTIS; INIS; GPO Dep.

Nondestructive assay (NDA) systems have been developed for use in an automated mixed oxide fabrication facility. Unique features have been developed for the NDA systems to accommodate

robotic sample handling and remote operation. In addition, the systems have been designed to obtain International Atomic Energy Agency inspection data without the need for an inspector at the facility at the time of the measurements. The equipment is being designed to operate continuously in an unattended mode with data storage for periods of up to one month. The design, performance characteristics, and authentication of the NDA systems are described. The data related to reliability, precision, and accuracy are presented.

25642 (WSRC-MS–93-174) **Comparison of a constraint directed search to a genetic algorithm in a scheduling application.** Abbott, L. Westinghouse Savannah River Co., Aiken, SC (United States). [1993]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-9309128–1: International symposium on artificial intelligence, Monterrey (Mexico), 22-24 Sep 1993). Order Number DE93011784. Source: OSTI; NTIS; INIS; GPO Dep.

Scheduling plutonium containers for blending is a time-intensive operation. Several constraints must be taken into account; including the number of containers in a dissolver run, the size of each dissolver run, and the size and target purity of the blended mixture formed from these runs. Two types of algorithms have been used to solve this problem: a constraint directed search and a genetic algorithm. This paper discusses the implementation of these two different approaches to the problem and the strengths and weaknesses of each algorithm.

0508 Spent Fuels Reprocessing

Refer also to citation(s) 25763, 25845, 25884, 26194, 26844, 27473

25643 (CEA-R–5628) **Construction of a system for aid in running irradiated fuel reprocessing facilities.** Allanic, A.L. CEA Centre d'Etudes de la Vallee du Rhone, 30 - Marcoule (France). Dept. des Procedes de Retraitement. Jan 1993. [186p.] (In French). Order Number DE93630365. Source: OSTI; NTIS (US Sales Only); INIS.

The availability of a diagnostic aid tool may prove to be extremely useful for monitoring complex processes such as those employed in nuclear fuel reprocessing plants. In the case of a malfunction, the choice of a corrective action demands the accurate knowledge of the disturbed state, because the same action applied to two distinct states of the process may have different consequences. The very high non-linearity of the responses of the process and the complexity of the mechanisms involved preclude the use of expert systems to perform the diagnosis. It was therefore decided to construct a diagnostic program based on the use of an available model allowing the dynamic simulation of the process. The program serves to identify a disturbance from its consequences, thus in some way achieving the 'inversion' of the model. The method adopted uses a regular mesh of a disturbance space and uses simulation to calculate the corresponding response space, in which a point close to the measured response is identified, thus helping to locate the disturbance. Tests on simulated and experimental data proved fairly conclusive, making it possible to consider the application of techniques used in industrial processes, despite the scale of the data processing resources required.

25644 (ETDE-IT–93-195) **Utilization of ENEA's EUREX pilot reprocessing plant for treatment and conditioning of HLLWs.** Calle, C.; Alonzo, G.; Raspollini, M.; Luce, A. ENEA, Saluggia (Italy). Area Nucleare. 1992. 8p. (CONF-920851–95: Spectrum '92: nuclear and hazardous waste management international topical meeting, Boise, ID (United States), 23-27 Aug 1992). Order Number DE93799300. Source: OSTI; NTIS (US Sales Only); INIS.

During the 1970-80's, the operation of the two ENEA (Italian Agency for Energy, New Technologies and the Environment) pilot reprocessing plants has produced 115 cubic meters of high-level liquid wastes (HLLW's) coming from MTR, CANDU and ELK River spent fuels. A selective separation process has been developed during the last 5 years to perform the chemical treatment and conditioning of that non-conventional type of HLLW. The conditioning process consists of the selective separation of the waste into two fractions, high and low radioactive; the cementation of the low level fraction using standard MOWA technology is planned, while a small size vitrification unit, based on the ceramic melter technology, is under consideration for the high active fraction. A special study (COREX Project) was done to fit the new equipment into some existing process cells of the old pilot EUREX reprocessing plant, to be decommissioned, with the scope of minimizing construction costs.

25645 (HW–65806-RD) **Radiant-heat spray-calcination process for the solid fixation of radioactive waste: Part 1, Non-radioactive pilot unit.** Allemann, R.T.; Johnson, B.M. Jr. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 14 Nov 1960. 81p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93014662. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The fixation of radioactive waste in a stable solid media by means of calcination of these aqueous solutions has been the subject of considerable-effort throughout the U. S. Atomic Energy Commission and by atomic energy organizations in other countries. Several methods of doing this on a continuous or semi-continuous basis have been devised, and a fev have been demonstrated to be feasible for the handling of non-radioactive, or low-activity, simulated wastes. Notable among methods currently under development are: (a) batch-operated pot calcination of waste generated from reprocessing stainless steel clad fuel elements (Darex process) and Purex waste, (b) combination rotary kiln and ball mill calcination of aluminum nitrate (TBP-25 and Redox process), and (c) fluidized bed calcination of TBP-25 and Purex wastes. Although a considerable amount of engineering experience has been obtained on the calcination of dissolved salts in a fluidized bed, and the other methods have been the subjects of a great deal of study, none of them have been developed to-the extent which would rule out the desirability of further investigation of other possible methods of calcination.

25646 (INIS-mf–12758, pp. 322-330) **Thorium base fuels reprocessing at the L.P.R. (Radiochemical Processes Laboratory) experimental plant.** Almagro, J.C. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina). Gerencia de Procesos Quimicos); Dupetit, G.A.; Deandreis, R.A.; Kaufmann, F. Asociacion Argentina de Tecnologia Nuclear, Buenos Aires (Argentina). 1987. [735p.] (In Spanish). (CONF-8711355–: 15. scientific meeting and 4th Latin American meeting and 1st sessions on nuclear power plants, San Carlos de Bariloche (Argentina), 2-6 Nov 1987). In *Proceedings of the fifteenth scientific meeting; fourth Latin American meeting; first sessions on nuclear power plants.* Order Number DE91003052. Source: OSTI; NTIS (US Sales Only); INIS.

The availability of the LPR (Radiochemical Processes Laboratory) plant offers the possibility to demonstrate and create the necessary technological basis for thorium fuels reprocessing. To this purpose, the solvents extraction technique is used, employing TBP (at 30%) as solvent. The process is named THOREX, a one-cycle acid, which permits an adequate separation of Th^{232} and U^{233} components and fission products. For thorium oxide elements dissolution, the 'chopp-leach' process (installed at LPR) is used, employing a NO_3 H 13N, 0.05M FH and 0.1M Al $(NO_3)_3$, as solvent. To adapt the pilot plant to the flow-sheet requirements proposed, minor modifications must be carried out in the interconnection of the existing decanting mixers. The input of the plant has been calculated by Origin Code modified for irradiations in reactors of the HWR type. (Author).

25647 (INIS-mf–12758, pp. 338-344) **Capacity limits in columns pulsed with stain steel perforated plates.** Maset, E.R. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina). Gerencia de Procesos Quimicos); Acosta, E.; Di Piano, M.; Maymo, J.A. Asociacion Argentina de Tecnologia Nuclear, Buenos Aires (Argentina). 1987. [735p.] (In Spanish). (CONF-8711355–: 15. scientific meeting and 4th Latin American meeting and 1st sessions on nuclear power plants, San Carlos de Bariloche (Argentina), 2-6 Nov 1987). In *Proceedings of the fifteenth scientific meeting; fourth Latin American meeting; first sessions on nuclear power plants.* Order Number DE91003052. Source: OSTI; NTIS (US Sales Only); INIS.

This paper includes part of the second stage of the pulsed columns development program, using a water-nitric acid system as

continuous phase and tri-n-butyl phosphate dissolved in kerosene at 30% v/v as disperse phase. Two kits of different geometry perforated plates (different diameter of perforation and free area percentage) were used. Due to the affinity importance of the plates' material with the continuous phase, in all the cases the continuous aqueous phase was used. The relation of flows varied, thus obtaining in each case a curve of characteristic 'flood'. The influence of the geometrical variables, the relation of flows, the medium acidity and the pulse's amplitude was applied in the capacity of the column. Besides, the dimensional correlation of Swift W.H. on the results obtained from 'flood' with both kits of plates to relate flows 1:1 and a minimum deviation was observed. (Author).

25648 (INIS-mf–12758, pp. 358-363) **Formulation development and preparation of simulated high reactivity wastes of HWR (heavy water reactors) type.** Bevilacqua, A.M. (Comision Nacional de Energia Atomica, San Carlos de Bariloche (Argentina). Centro Atomico Bariloche); Messi de Bernasconi, N.B.; Sterba, M.E. Asociacion Argentina de Tecnologia Nuclear, Buenos Aires (Argentina). 1987. [735p.] (In Spanish). (CONF-8711355–: 15. scientific meeting and 4th Latin American meeting and 1st sessions on nuclear power plants, San Carlos de Bariloche (Argentina), 2-6 Nov 1987). In *Proceedings of the fifteenth scientific meeting; fourth Latin American meeting; first sessions on nuclear power plants.* Order Number DE91003052. Source: OSTI; NTIS (US Sales Only); INIS.

The quantities of elements in the nitric solution of high reactivity wastes originated in the reprocessing of HWR fuels, burnup 605 G J/Kg U (7000 MW d/ton U) were calculated from the results of ORIGEN code. The contribution to the nitric solution of gaseous and volatile compounds, actinides and corrosion and decomposition products of the organic phase were determined. Reduction criteria for scarce elements and substitution criteria for unavailable elements were developed. An original feature of the simulation is the use of uranium as substitute for actinides. The simulation refers to the concentrated nitric solution, which is temporarily stored in liquid state after the reprocessing. On the basis of results, contributions and above mentioned criteria, the nitric solution was prepared with compounds selected for its solubility in 3 M NO3 H. An heterogeneous system was obtained, formed by a solution of some of the substances and a fine suspension that sediment ed. (Author).

25649 (INIS-mf–12758, pp. 364-369) **High activity wastes immobilization in sintered glasses: simulated wastes of the HWR (heavy water reactors) type in a new formulation glass.** Bevilacqua, A.M. (Comision Nacional de Energia Atomica, San Carlos de Bariloche (Argentina). Centro Atomico Bariloche); Messi de Bernasconi, N.B.; Audero, M.A. Asociacion Argentina de Tecnologia Nuclear, Buenos Aires (Argentina). 1987. [735p.] (In Spanish). (CONF-8711355–: 15. scientific meeting and 4th Latin American meeting and 1st sessions on nuclear power plants, San Carlos de Bariloche (Argentina), 2-6 Nov 1987). In *Proceedings of the fifteenth scientific meeting; fourth Latin American meeting; first sessions on nuclear power plants.* Order Number DE91003052. Source: OSTI; NTIS (US Sales Only); INIS.

The new formulation of boron silicate glass, of German origin, SG7, was specifically developed for high activity wastes immobilization by a sintering process. Using the pressing technique at room temperature and subsequent sintering, the sintering conditions of the pure glass and the incorporation of the 10% in weight of simulated wastes of the HWR type recently developed, have been studied. Besides, three ways of incorporation of wastes are presented: (a) incorporation of a coincidental compound obtained from chemical and thermal denitration; (b) incorporation of a calcination only obtained from thermal denitration; (c) incorporation of the nitric solution, mixing this one with the glass, and subsequent calcination. The results from the sintering studies and from the leaching assays of the MCC-1 are presented, and the microstructures observed are described. These results are compared with those previously obtained from boron silicate glasses of the VG type. Finally, results from long duration leaching assays, performed in samples obtained years before, are presented. (Author).

25650 (LA-UR–93-1843) **Safeguards Instruments for Large-Scale Reprocessing Plants.** Hakkila, E.A. (Los Alamos National Lab., NM (United States)); Case, R.S.; Sonnier, C. Los Alamos National Lab., NM (United States). [1993]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930913–3: Global '93: future nuclear systems - emerging fuel cycles and waste disposal options, Seattle, WA (United States), 12-17 Sep 1993). Order Number DE93014550. Source: OSTI; NTIS; GPO Dep.

Between 1987 and 1992 a multi-national forum known as LASCAR (Large Scale Reprocessing Plant Safeguards) met to assist the IAEA in development of effective and efficient safeguards for large-scale reprocessing plants. The US provided considerable input for safeguards approaches and instrumentation. This paper reviews and updates instrumentation of importance in measuring plutonium and uranium in these facilities.

25651 (WHC-SA–1812) **Use of the USQ process with an operating SAR for the shutdown/terminal cleanout of the PUREX facility.** Dodd, E.N. Westinghouse Hanford Co., Richland, WA (United States). Jun 1993. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (CONF-9306143–12: Energy Facility Contractors Group safety analysis meeting, Denver, CO (United States), 16-18 Jun 1993). Order Number DE93016223. Source: OSTI; NTIS; INIS; GPO Dep.

The Plutonium-Uranium Extraction (PUREX) facility at the Hanford Site is a remote canyon facility that began operations in 1956 to support the Atomic Energy Commission and later the Department of Energy in the recovery of plutonium, uranium, and neptunium from spent reactor fuel. This report follows the transition of the PUREX facility from standby mode in 1990 to shutdown/terminal cleanout. Preparation of the Final Safety Analysis Report (FSAR), evaluation of OSR requirements, and the use of the USQ to successfully complete the deactivation of the facility in a timely and cost effective manner are discussed. The major activities, both administrative and procedural, performed as part of the PUREX facility deactivation are described.

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Refer also to citation(s) 25736, 25793, 25852, 25853, 25854, 25868, 25879, 25899, 25902, 26904, 26916, 26917, 27375, 28152

25652 (CONF-920905–) **PATRAM '92: 10th international symposium on the packaging and transportation of radioactive materials.** Sandia National Labs., Albuquerque, NM (United States). [1992]. 280p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. From PATRAM '92: 10th international symposium on the packaging and transportation of radioactive materials; Yokohama (Japan); 13-18 Sep 1992. Order Number DE93013222. Source: OSTI; NTIS; INIS; GPO Dep.

This document provides the papers presented by Sandia Laboratories at PATRAM '92, the tenth International symposium on the Packaging and Transportation of Radioactive Materials held September 13–18, 1992 in Yokohama City, Japan. Individual papers have been cataloged separately.

25653 (CONF-930408–78) **The impact of using reduced capacity baskets on cask fleet size and cask fleet mix.** Joy, D.S. (Oak Ridge National Lab., TN (US)); Johnson, P.E.; Andress, D.A. Oak Ridge National Lab., TN (United States). [1993]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From International high-level radioactive waste management conference; Las Vegas, NV (United States); 25-29 Apr 1993. Order Number DE93015296. Source: OSTI; NTIS; INIS; GPO Dep.

The Civilian Radioactive Waste Management System transportation system will encounter a wide range of spent fuel characteristics. Since the Initiative I casks are being designed to transport 10-year-old fuel with a burnup of 35,000 MWd/MTU, there is a good likelihood that a number of the cask shipments will need to be derated in order to meet the Nuclear Regulatory Commission radiation guidelines. This report discusses the impact of cask derating by using reduced-capacity baskets. Cask derating, while enhancing the ability to move spent fuel with a wider range of age and burnup characteristics, increases the number of shipments; the amount of equipment (cask bodies, baskets, etc.); and the number

of visits to both shipping and receiving sites required to transport a specific amount of spent fuel.

25654 (DOE/CH/10324–T1) **Lessons learned by southern states in transportation of radioactive materials.** Southern States Energy Board, Norcross, GA (United States). Mar 1992. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC01-87CH10324. Order Number DE93016297. Source: OSTI; NTIS; INIS; GPO Dep.

This report has been prepared under a cooperative agreement with DOE's Office of Civilian Radioactive Waste Management (OCRWM) and is a summary of the lessons learned by southern states regarding the transportation of radioactive materials including High-Level Radioactive Wastes (HLRW) and Spent Nuclear Fuel (SNF). Sources used in this publication include interviews of state radiological health and public safety officials that are members of the Southern States Energy Board (SSEB) Advisory Committee on Radioactive Materials Transportation, as well as the Board's Transuranic (TRU) Waste Transportation Working Group. Other sources include letters written by the above mentioned committees concerning various aspects of DOE shipment campaigns.

25655 (DOE/CH/10324–T2) **Spent Fuel and High-Level Radioactive Waste Transportation Report.** Southern States Energy Board, Norcross, GA (United States). Mar 1992. 133p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC01-87CH10324. Order Number DE93016298. Source: OSTI; NTIS; INIS; GPO Dep.

This publication is intended to provide its readers with an introduction to the issues surrounding the subject of transportation of spent nuclear fuel and high-level radioactive waste, especially as those issues impact the southern region of the United States. It was originally issued by SSEB in July 1987 as the Spent Nuclear Fuel and High-Level Radioactive Waste Transportation Primer, a document patterned on work performed by the Western Interstate Energy Board and designed as a "comprehensive overview of the issues." This work differs from that earlier effort in that it is designed for the educated layman with little or no background in nuclear waste issues. In addition. this document is not a comprehensive examination of nuclear waste issues but should instead serve as a general introduction to the subject. Owing to changes in the nuclear waste management system, program activities by the US Department of Energy and other federal agencies and developing technologies, much of this information is dated quickly. While this report uses the most recent data available, readers should keep in mind that some of the material is subject to rapid change. SSEB plans periodic updates in the future to account for changes in the program. Replacement pages will be supplied to all parties in receipt of this publication provided they remain on the SSEB mailing list.

25656 (DOE/CH/10324–T3) **An examination of the Hazardous Materials Transportation Uniform Safety Act (HMTUSA): A southern perspective.** Southern States Energy Board, Norcross, GA (United States). Mar 1992. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC01-87CH10324. Order Number DE93016299. Source: OSTI; NTIS; INIS; GPO Dep.

On November 16,1990, President Bush signed into law the most comprehensive amendments to the Hazardous Materials Transportation Act (HMTA) in 15 years. The Hazardous Materials Transportation Uniform Safety Act of 1990 (HMTUSA) was created by Congress in an effort to strengthen and clarify the HMTA. This paper will discuss the act's provisions as they affect shipments of spent fuel and high-level radioactive materials as well as the impact of those provisions on routing and emergency response issues in the southern region. HMTUSA consists of seven key provisions that affect radioactive materials: clarification of regulatory jurisdiction; highway routing standards; broadened industry registration; safety permits for motor carriers of high risk materials; expanded nuclear transportation requirements; new provisions for emergency response training and planning; and a public process for assessing the feasibility of a federally operated central reporting system and data center. In addition to amending various HMTA provisions, the new HMTUSA act provides appropriations to carry out the specific goals of the legislation. The act authorizes appropriations for the 1991, 1992 and 1993 fiscal years.

25657 (DOE/CH/10324–T5) **Radiological transportation emergency response training course funding and timing in the southern states.** Southern States Energy Board, Norcross, GA (United States). Oct 1991. 42p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC01-87CH10324. Order Number DE93016301. Source: OSTI; NTIS; INIS; GPO Dep.

The following is a review of the enabling statutes of 16 southern states regarding training for personnel preparing for or responding to a transportation-related emergency involving highway route-controlled quantities of spent fuel and high-level radioactive waste. This report outlines the funding sources and procedures for administering funds for programs attended by state and local officials. Additionally, the report outlines the views of emergency response officials in the southern states concerning the timing and administration of future federal assistance to be provided under §180(c) of the Nuclear Waste Policy Amendments Act. Under §180(c) of the Nuclear Waste Policy Amendments Act of 1987, the US Department of Energy (DOE) is required to provide technical assistance and funds to states for training public safety officials of appropriate units of local government and Indian tribes when spent nuclear fuel or high-level radioactive waste is transported through their jurisdictions. The Comprehensive Cooperative Agreement (CCA) is the primary funding mechanism for federal assistance to states for the development of their overall emergency management capabilities. FEMA supports 12 separate emergency management programs including the Emergency Management Training program (EMT). This program provides funds for emergency management training and technical assistance to states for unique state training needs. Funds may be used for instructors, students and other related costs.

25658 (DOE/CH/10324–T6) **Southern States' Routing Agency Report.** Southern States Energy Board, Norcross, GA (United States). Feb 1988. 27p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC01-87CH10324. Order Number DE93016302. Source: OSTI; NTIS; INIS; GPO Dep.

The Southern States' Routing Agency Report is a compendium of 16-southern states' routing programs and authorities for high-level radioactive materials transportation. The report includes the identification of each state's designated routing agency and state legislation and regulations pertaining specifically to the shipment routing of high-level radioactive materials. Using information collected and compiled by the Hazardous Materials Information Group at Oak Ridge National Laboratory, the report also addresses local government routing restrictions for high-level radioactive materials transportation. Whether local or state routing restrictions have been legally challenged and found to be inconsistent and preempted by the federal Hazardous Materials Transportation Act of 1974 (49 App. USC. 1801 et seq.) is noted. Finally, the state agency and contact designated by each state's governor to receive advance notification and shipment routing information under 10 Code of Federal Regulations (CFR) Parts 71 and 73 is listed.

25659 (DOE/CH/10324–T7) **Southern states radiological emergency response laws and regulations.** Southern States Energy Board, Norcross, GA (United States). Jul 1989. 34p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC01-87CH10324. Order Number DE93016303. Source: OSTI; NTIS; INIS; GPO Dep.

The purpose of this report is to provide a summary of the emergency response laws and regulations in place in the various states within the southern region for use by legislators, emergency response planners, the general public and all persons concerned about the existing legal framework for emergency response. SSEB expects to periodically update the report as necessary. Radiation protection regulations without emergency response provisions are not included in the summary.

25660 (DOE/CH/10324–T8) **Alternative routes for highway shipments of radioactive materials and lessons learned from state designations.** Southern States Energy Board, Norcross, GA (United States). Jul 1990. 65p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC01-87CH10324. Order Number DE93016305. Source: OSTI; NTIS; INIS; GPO Dep.

Pursuant to the Hazardous Materials Transportation Act (HMTA), the Department of Transportation (DOT) has promulgated a comprehensive set of regulations regarding the highway transportation

of high-level radioactive materials. These regulations, under docket numbers HM-164 and HM-164A, establish interstate highways as the preferred routes for the transportation of radioactive materials within and through the states. The regulations also provide a methodology by which a state may select alternative routes. First, the state must establish a "state routing agency", defined as an entity authorized to use the state legal process to impose routing requirements on carriers of radioactive material (49 CFR 171.8). Once identified, the state routing agency must select routes in accordance with DOTs Guidelines for Selecting Preferred Highway Routes for Large Quantity Shipments of Radioactive Materials or an equivalent routing analysis. Adjoining states and localities should be consulted on the impact of proposed alternative routes as a prerequisite of final route selection. Lastly, the states must provide written notice to DOT of any alternative route designation before the routes are deemed effective. The purpose of this report is to discuss the "lessons learned" by the five states within the southern region that have designated alternative or preferred routes under the regulations of the Department of Transportation (DOT) established for the transportation of radioactive materials. The document was prepared by reviewing applicable federal laws and regulations, examining state reports and documents and contacting state officials and routing agencies involved in making routing decisions. In undertaking this project, the Southern States Energy Board hopes to reveal the process used by states that have designated alternative routes and thereby share their experiences (i.e., lessons learned) with other southern states that have yet to make designations.

25661 (DOE/CH/10324–T10) **Southern routes for high-level radioactive waste: Agencies, contacts, and designations.** Southern States Energy Board, Norcross, GA (United States). May 1991. 80p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC01-87CH10324. Order Number DE93016307. Source: OSTI; NTIS; INIS; GPO Dep.

The Southern Routes for High-Level Radioactive Waste: Agencies, Contacts and Designations is a compendium of sixteen southern states' routing programs for the transportation of high-level radioactive materials. The report identifies the state-designated routing agencies as defined under 49 Code of Federal Regulations (CFR) Part 171 and provides a reference to the source and scope of the agencies' rulemaking authority. Additionally, the state agency and contact designated by the state's governor to receive advance notification and shipment routing information under 10 CFR Parts 71 and 73 are also listed. This report also examines alternative route designations made by southern states and the lessons that were learned from the designation process.

25662 (DOE/CH/10324–T11) **Southern States' Routing Agency Report.** Southern States Energy Board, Norcross, GA (United States). Mar 1990. 28p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC01-87CH10324. Order Number DE93016308. Source: OSTI; NTIS; INIS; GPO Dep.

The Southern States' Routing Agency Report is a compendium of 16-southern states' routing program for the transportation of high-level radioactive materials. The report identifies the state-designated routing agencies as defined under 49 Code of Federal Regulations (CFR) Part 171 and provides a reference to the source and scope of the agencies' rulemaking authority. Additionally, the state agency and contact designated by the state's governor to receive advance notification and shipment routing information under 10 CFR Parts 71 and 73 are also listed.

25663 (DOE/CH/10324–T14) **Lessons learned by southern states in designating alternative routes.** Southern States Energy Board, Norcross, GA (United States). Aug 1989. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC01-87CH10324. Order Number DE93016311. Source: OSTI; NTIS; INIS; GPO Dep.

The purpose of this report is to discuss the "lessons learned" by the five states within the southern region that have designated alternative or preferred routes under the regulations of the Department of Transportation (DOT) established for the transportation of radioactive materials. The document was prepared by reviewing applicable federal laws and regulations, examining state reports and documents and contacting state officials and routing agencies involved in making routing decisions. In undertaking this project, the Southern States Energy Board hopes to reveal the process used by states that have designated alternative routes and thereby share their experiences (i.e., lessons learned) with other southern states that have yet to make designations. Under DOT regulations (49 CFR 177.826), carriers of highway route controlled quantities of radioactive materials (which include spent nuclear fuel and high-level waste) must use preferred routes selected to reduce time in transit. Such preferred routes consist of (1) an interstate system highway with use of an interstate system bypass or beltway around cities when available, and (2) alternate routes selected by a "state routing agency."

25664 (DOE/CH/10324–T16) **Southern State Radiological Transportation Emergency Response Training Course Summary.** Southern States Energy Board, Norcross, GA (United States). Sep 1990. 50p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC01-87CH10324. Order Number DE93016313. Source: OSTI; NTIS; INIS; GPO Dep.

The Southern States Energy Board (SSEB) is an interstate compact organization that serves 16 states and the commonwealth of Puerto Rico with information and analysis in energy and environmental matters. Nuclear waste management is a topic that has garnered considerable attention in the SSEB region in the last several years. Since 1985, SSEB has received support from the US Department of Energy for the regional analysis of high-level radioactive waste transportation issues. In the performance of its work in this area, SSEB formed the Advisory Committee on High-Level Radioactive Materials Transportation, which comprises representatives from impacted states and tribes. SSEB meets with the committee semi-annually to provide issue updates to members and to solicit their views on activities impacting their respective states. Among the waste transportation issues considered by SSEB and the committee are shipment routing, the impacts of monitored retrievable storage, state liability in the event of an accident and emergency preparedness and response. This document addresses the latter by describing the radiological emergency response training courses and programs of the southern states, as well as federal courses available outside the southern region.

25665 (DOE/CH/10324–T18) **Spent fuel and high-level radioactive waste transportation report.** Southern States Energy Board, Norcross, GA (United States). Nov 1990. 139p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC01-87CH10324. Order Number DE93016315. Source: OSTI; NTIS; INIS; GPO Dep.

This publication is intended to provide its readers with an introduction to the issues surrounding the subject of transportation of spent nuclear fuel and high-level radioactive waste, especially as those issues impact the southern region of the United States. It was originally issued by the Southern States Energy Board (SSEB) in July 1987 as the Spent Nuclear Fuel and High-Level Radioactive Waste Transportation Primer, a document patterned on work performed by the Western Interstate Energy Board and designed as a "comprehensive overview of the issues." This work differs from that earlier effort in that it is designed for the educated layman with little or no background in nuclear waste issues. In addition, this document is not a comprehensive examination of nuclear waste issues but should instead serve as a general introduction to the subject. Owing to changes in the nuclear waste management system, program activities by the US Department of Energy and other federal agencies and developing technologies, much of this information is dated quickly. While this report uses the most recent data available, readers should keep in mind that some of the material is subject to rapid change. SSEB plans periodic updates in the future to account for changes in the program. Replacement pages will be supplied to all parties in receipt of this publication provided they remain on the SSEB mailing list.

25666 (DOE/CH/10324–T20) **Rail abandonments in the South and their effect on NWPA rail shipments.** Southern States Energy Board, Norcross, GA (United States). Feb 1988. 36p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC01-87CH10324. Order Number DE93016317. Source: OSTI; NTIS; INIS; GPO Dep.

The railroad industry will have a very critical role in the eventual shipping of commercial spent fuel and defense high-level waste as provided under the Nuclear Waste Policy Act of 1982 and the 1987 amendments. The transport of spent fuel is expected to be accomplished by rail from 19 of the South's 27 reactor sites to the proposed Yucca Mountain repository or possible monitored retrievable storage facility. The decline in total track availability, however, could significantly impact the federal government's transportation program. Particularly the situation of continuing abandonments may limit rail opportunities at numerous reactor locations. Commercial nuclear reactor sites have the unfortunate problem of not being located on Class I railroad mainline tracks. The reactor sites are generally located in areas with limited rail traffic and thus vulnerable to rail abandonment procedures. The general deregulation of the railroad industry under the Staggers Act of 1980 also assisted in making rail abandonment, through the Interstate Commerce Commission, a rather simple and quick process. The effects of deregulation, however, have provided alternatives to abandonment. In particular, the Staggers Act has led to an enormous surge in the growth of short line and regional railroads. Such railroads have been able to effectively operate rail lines which Class I railroads found unprofitable. The short lines and regionals were also encouraged to competitively negotiate contracts directly with shippers. While these railroads may help reduce the number of abandonment applications, they may also represent higher shipping costs. The South has experienced a great number of abandonments since the 1960's. Many of the abandonments have been significant in length and have affected areas near nuclear plants expected to ship by rail.

25667 (DOE/CH/10324–T21) **The rail abandonment process: A southern perspective.** Southern States Energy Board, Norcross, GA (United States). Dec 1988. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC01-87CH10324. Order Number DE93016318. Source: OSTI; NTIS; INIS; GPO Dep.

One factor in evaluating the desirability of rail transport for high-level radioactive wastes or spent fuels is the frequency, or lack thereof, with which railroad and railroad lines have been, and are, abandoned. If DOE makes a decision to use the rail option and a line is subsequently abandoned, the choice results in increased cost, time delays and possibly safety problems: Information is therefore needed prior to the decision-making process to evaluate the desirability of the rail shipping option. One result of the abandonments mentioned herein, as well as other later abandonments, is the creation of a US rail system undergoing an evolutionary process in the 1980s as far-reaching as the changes that occurred when the industry was in its infancy a century and-a-half ago. The purpose of this paper is to examine the factors leading to some of these changes by tracing the historical development of the rail abandonment process, with particular emphasis on the rise of regional railroads, their problems in the modern era and current trends in rail abandonments as well as their effects on the southeastern United States.

25668 (DOE/CH/10324–T22) **Spent fuel and high-level radioactive waste transportation report.** Southern States Energy Board, Norcross, GA (United States). Nov 1989. 137p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC01-87CH10324. Order Number DE93016319. Source: OSTI; NTIS; INIS; GPO Dep.

This publication is intended to provide its readers with an introduction to the issues surrounding the subject of transportation of spent nuclear fuel and high-level radioactive waste, especially as those issues impact the southern region of the United States. It was originally issued by the Southern States Energy Board (SSEB) in July 1987 as the Spent Nuclear Fuel and High-Level Radioactive Waste Transportation Primer, a document patterned on work performed by the Western Interstate Energy Board and designed as a "comprehensive overview of the issues." This work differs from that earlier effort in that it is designed for the educated layman with little or no background in nuclear waste issues. In addition, this document is not a comprehensive examination of nuclear waste issues but should instead serve as a general introduction to the subject. Owing to changes in the nuclear waste management system, program activities by the US Department of Energy and other federal agencies and developing technologies, much of this information is dated quickly. While this report uses the most recent data available, readers should keep in mind that some of the material is subject to rapid change. SSEB plans periodic updates in the future to account for changes in the program. Replacement pages sew be supplied to all parties in receipt of this publication provided they remain on the SSEB mailing list.

25669 (DOE/CH/10324–T23) **Report on state liability for radioactive materials transportation incidents: A survey of laws.** Southern States Energy Board, Norcross, GA (United States). Oct 1989. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC01-87CH10324. Order Number DE93016320. Source: OSTI; NTIS; INIS; GPO Dep.

The purpose of this report is to provide a synopsis of the liability laws of the Southern States Energy Board's (SSEB's) 16 member states. It begins by briefly reviewing potential sources of liability, immunity from liability, waiver of immunity, and statutes of limitation, followed by liability laws of member states. The report was prepared by reviewing legal literature pertaining to governmental liability, with particular emphasis on nuclear waste transportation, including law review articles, legal treatises, technical reports, state statutes and regulations.

25670 (DOE/CH/10324–T24) **Southern states' routing agency report.** Southern States Energy Board, Norcross, GA (United States). Feb 1989. 22p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC01-87CH10324. Order Number DE93016321. Source: OSTI; NTIS; INIS; GPO Dep.

The Southern states' routing agency report is a compendium of 16-southern states' routing programs relative to the transportation of high-level radioactive materials. The report identifies the state-designated routing agencies as defined under 49 Code of Federal Regulations (CFR) Part 171 and provides a reference to the source ad scope of the agencies' rulemaking authority. Additionally, the state agency and contact designated by the state's governor to receive advance notification and shipment routing information under 10 CFR Parts 71 and 73 are also listed.

25671 (DOE/CH/10324–T25) **Transportation infrastructure upgrades in the South: A compilation of state plans for construction near nuclear reactor sites.** Southern States Energy Board, Norcross, GA (United States). Mar 1992. 137p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC01-87CH10324. Order Number DE93016287. Source: OSTI; NTIS; INIS; GPO Dep.

There are currently 27 nuclear reactor sites located in the southern region. In many instances, the most practicable modes of transportation of spent nuclear fuel from these sites we through the use of highway and rail systems. These two transportation modes have important differences that affect their applicability; chief among these, perhaps, is the fact that while highway systems are publicly owned and maintained rail lines are owned by private entities. For this reason, track condition and maintenance, usage rates and other aspects of rail transport can vary widely. This report reviews southern state, department plans for infrastructure upgrades in the vicinity of nuclear reactor sites. This report includes a summary of planned modifications to bridges, access highways, and rail spurs (where applicable) over the next five years. The information contained herein was gathered from interviews with officials within state departments of transportation. With few exceptions, the contact person was an official within the departmental planning division.

25672 (INIS-GB–489) **Statement of nuclear incidents (4th Qtr. 1990): Sellafield Nuclear Processing Plant, Cumbria (BNFL); Dounreay Nuclear Power Development Establishment (UKAEA); Winfrith Atomic Energy Establishment (UKAEA).** Health and Safety Executive, London (United Kingdom). Apr 1991. [5p.] Order Number DE93631012. Source: OSTI; NTIS (US Sales Only); INIS.

Three incidents were reported in the fourth quarter of 1990. The first concerned the contamination of worker when loading used equipment prior to its decontamination. This resulted in his total

yearly radiation dose being in excess of the annual dose limits. At the UKAEA Dounreay site a small quantity of radioactive liquid leaked from a drum onto a road during the transfer of low level radioactive waste. The road surface was removed and disposed of. Two operators at the UKAEA Winfrith site were contaminated whilst operating equipment to compact radioactive waste in drums. The doses to the workers were in excess of the statutory dose limits. Investigations into all the incidents resulted in steps to improve safety. (UK).

25673 (INIS-mf–12758, pp. 504-508) **Hydraulic breakage of tanks for the transport of uranium hexafluoride (UF_6).** Biaggio, A.L. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina). Gerencia de Seguridad Radiologica y Nuclear); Lee Gonzales, H.M.; Lopez Vietri, J.R.; Novo, R.G. Asociacion Argentina de Tecnologia Nuclear, Buenos Aires (Argentina). 1987. [735p.] (In Spanish). (CONF-8711355–: 15. scientific meeting and 4th Latin American meeting and 1st sessions on nuclear power plants, San Carlos de Bariloche (Argentina), 2-6 Nov 1987). In *Proceedings of the fifteenth scientific meeting; fourth Latin American meeting; first sessions on nuclear power plants.* Order Number DE91003052. Source: OSTI; NTIS (US Sales Only); INIS.

To begin with, the tank models that are proposed by the international norms for the transport and storage of hexafluoride of uranium (UF_6) are briefly described. The operations related to the transport in its different forms are also described, particularly those that can produce the hydraulic breakage of tanks during its course or in later stages, when incorrectly performed. With reference to those operations, the most important physicochemical properties of UF_6 as for safety are analyzed. A quantitative evaluation of the deviations of parameters that are controlled during the heating of tanks, comparing them with the normative nominal values, is performed. Adopting some simplifying hypothesis, a general study, applicable to all tank models proposed by norms, is carried out to determine the temperature at which the hydraulic breakage takes place when they are heated in closed-valve conditions. A curve is obtained by plotting the hydraulic breakage temperature against the filling degree. To conclude, the values obtained are compared with the results of other theoretical studies on this subject. (Author).

25674 (SAND–92-2237C) **Inelastic analysis acceptance criteria for radioactive material transportation containers.** Ammerman, D.J.; Ludwigsen, J.S. Sandia National Labs., Albuquerque, NM (United States). [1993]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-930702–28: Pressure vessels and piping conference, Denver, CO (United States), 25-29 Jul 1993). Order Number DE93015021. Source: OSTI; NTIS; INIS; GPO Dep.

The design criteria currently used in the design of radioactive material (RAM) transportation containers are taken from the ASME Boiler and Pressure Vessel Code (ASME, 1992). These load-based criteria are ideally suited for pressure vessels where the loading is quasistatic and all stresses are in equilibrium with externally applied loads. For impact events, the use of load-based criteria is less supportable. Impact events tend to be energy controlled, and thus, energy-based acceptance criteria would appear to be more appropriate. Determination of an ideal design criteria depends on what behavior is desired. Currently there is not a design criteria for inelastic analysis for RAM nation packages that is accepted by the regulatory agencies. This lack of acceptance criteria is one of the major factors in limiting the use of inelastic analysis. In this paper inelastic analysis acceptance criteria based on stress and strain-energy density will be compared for two stainless steel test units subjected to impacts onto an unyielding target. Two different material models are considered for the inelastic analysis, a bilinear fit of the stress-strain curve and a power law hardening model that very closely follows the stress-strain curve. It is the purpose of this paper to stimulate discussion and research into the area of strain-energy density based inelastic analysis acceptance criteria.

25675 (UCRL-JC–110276) **System response of a DOE Defense Program package in a transportation accident environment.** Chen, T.F.; Hovingh, J.; Kimura, C.Y. Lawrence Livermore National Lab., CA (United States). 15 Oct 1992. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9301102–6: American Nuclear Society (ANS) meeting, Clearwater, FL (United States), 27 Jan 1993). Order Number DE93013852. Source: OSTI; NTIS; INIS; GPO Dep.

The system response in a transportation accident environment is an element to be considered in an overall Transportation System Risk Assessment (TSRA) framework. The system response analysis uses the accident conditions and the subsequent accident progression analysis to develop the accident source term, which in turn, is used in the consequence analysis. This paper proposes a methodology for the preparation of the system response aspect of the TSRA.

25676 (WHC-SA–1772) **Low specific activity and surface-contaminated objects determinations key to managing low-level wastes.** McCall, D.L. Westinghouse Hanford Co., Richland, WA (United States). Jan 1993. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (CONF-930205–61: Waste management '93, Tucson, AZ (United States), 28 Feb - 4 mar 1993). Order Number DE93011275. Source: OSTI; NTIS; INIS; GPO Dep.

Today's nuclear industry should be concerned that some waste shippers are improperly classifying low-level waste as low specific activity radioactive material for packaging and transportation to waste disposal facilities. If low-level waste is improperly classified, wrong packaging systems may be used, communication standards may not be met, and safety problems may be created. This paper discusses US Department of Transportation (DOT) criteria used for classifying LLW as LSA materials or as SCOS. Waste management procedures to ensure that nuclear facilities use defining criteria correctly when preparing waste for shipment and disposal also are discussed.

0510 Economic, Industrial, and Business Aspects

Refer also to citation(s) 25680, 25691, 25701

25677 (NUREG–1307-Rev.3) **Report on waste burial charges: Escalation of decommissioning waste disposal costs at low-level waste burial facilities: Revision 3.** Nuclear Regulatory Commission, Washington, DC (United States). Div. of Regulatory Applications. May 1993. 45p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Source: OSTI; NTIS; INIS; GPO.

One of the requirements placed upon nuclear power reactor licensees by the US Nuclear Regulatory Commission (NRC) is for the licensees to periodically adjust the estimate of the cost of decommissioning their plants, in dollars of the current year, as part of the process to provide reasonable assurance that adequate funds for decommissioning will be available when needed. This report, which is scheduled to be revised periodically, contains the development of a formula for escalating decommissioning cost estimates that is acceptable to the NRC. The sources of information to be used in the escalation formula are identified, and the values developed for the escalation of radioactive waste burial costs, by site and by year, are given. The licensees may use the formula, the coefficients, and the burial escalation factors from this report in their escalation analyses, or they may use an escalation rate at least equal to the escalation approach presented herein. This third revision of NUREG-1307 contains revised spreadsheet results for the disposal costs for the reference PWR and the reference BWR and the ratios of disposal costs at the Washington, Nevada, and South Carolina sites for the years 1986, 1988 and 1991, superseding the values given in the July 1991 issue of this report. Burial cost surcharges mandated by the Low-Level Radioactive Waste Policy Amendments Act of 1985 (LLRWPAA) have been incorporated into the revised ratio tables for those years. In addition, spreadsheet results for the disposal costs for the reference reactors and ratios of disposal costs at the two remaining burial sites in Washington and South Carolina for the year 1993 are provided. These latter results do not include any LLRWPAA surcharges, since those provisions of the Act expired at the end of 1992.

0520 Waste Management

Refer also to citation(s) 25644, 25672, 25676, 25677, 25849, 25857, 25860, 25863, 25865, 25868, 25870, 25877, 25884, 25900, 26119, 26128, 26132, 26133, 26161, 26312, 26424, 26542, 26771, 26810, 26811, 26882, 27329, 27430, 27435, 27452, 27461, 27465, 27467, 27471, 27472, 27475, 27498, 27511, 27512, 27513, 27640, 27665, 28089, 28092, 28154, 28155

25678 (ANL/CHM/CP–75735) **Combined TRU-Sr extraction/recovery process.** Horwitz, E.P. (Argonne National Lab., IL (United States)); Dietz, M.L.; Diamond, H.; Leonard, R.A.; Rogers, R.D. Argonne National Lab., IL (United States). [1992]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-930945–4: International solvent extraction conference (ISEC '93), York (United Kingdom), 9-15 Sep 1993). Order Number DE93003979. Source: OSTI; NTIS; GPO Dep.

The combined TRU-SR extraction/recovery process is a new solvent extraction process that is designed to extract uranium, neptunium, plutonium, americium, strontium, and technetium from dissolved sludge obtained from Hanford waste storage tanks. The process utilizes a solvent formulation consisting of 0.2 M octyl(phenyl)-N,N-diisobutyl-carbainoylmethylphosphine oxide (CMPO), 0.2 M 4,4 inches (5 inches)-di-t-butylcyclohexanol8-crown-6 (DtBuCH18C6),-and 1.2 M diamyl amylphosphonate (DA[AP]) in an isoparaffinic hydrocarbon diluent. Distribution ratios of Am, Sr, and T_c(the least extractable constituents) from synthetic waste containing 3 M $HN0_3$ are 40, 8, and 3, respectively. Selective backextraction of Np, Pu, Am, and Sr from U and $T_c$is achieved using a new carboxylic acid reagent. Uranium and technetium backextraction is achieved with 0.25 M Na_2CO_3. A flowsheet has been designed for testing the combined process in high speed centrifugal contactors. Synthetic dissolved sludge waste spiked with U, TRUs, ^{85}Sr and $^{99m}T_c$will be used as the feed. A sufficient number of stages are utilized to remove > 99.99% of the TRUs and Sr and > 90% of the T_c.

25679 (ANL/CMT/CP–78025) **A literature review of surface alteration layer effects on waste glass behavior.** Feng, X.; Cunnane, J.C.; Bates, J.K. Argonne National Lab., IL (United States). [1993]. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-930438–10: 95. annual meeting of the American Ceramic Society, Cincinnati, OH (United States), 18-22 Apr 1993). Order Number DE93012898. Source: OSTI; NTIS; INIS; GPO Dep.

When in contact with an aqueous solution, nuclear waste glass is subject to a chemical attack that results in progressive alteration. During tills alteration, constituent elements of the glass pass into the solution; elements initially in solution diffuse into, or are adsorbed onto, the solid; and new phases appear. This results in the formation of surface layers on the reacted glass. The glass corrosion and radionuclide release can be better understood by investigating these surface layer effects. In the past decade, there have been numerous studies regarding the effects of surface layers on glass reactions. This paper presents a systematic analysis and summary of the past knowledge regarding the effects of surface layers on glass-water interaction. This paper describes the major formation mechanisms of surface layers; reviews the role of surface layers in controlling mass transport and glass reaction affinity (through crystalline phases, an amorphous silica, a gel layer, or all the components in the glass); and discusses how the surface layers contribute to the retention of radionuclides during glass dissolution.

25680 (ANL/EAIS/CP–78643) **Trying to make an unwanted facility palatable.** Metz, W.C. Argonne National Lab., IL (United States). Environmental Assessment and Information Sciences Div. [1993]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-930408–57: International high-level radioactive waste management conference, Las Vegas, NV (United States), 25-29 Apr 1993). Order Number DE93009952. Source: OSTI; NTIS; INIS; GPO Dep.

Finding suitable accommodations for the temporary storage and permanent disposal of this: nation's low- and high-level radioactive waste is proving an ever more difficult task in this era of volatile technology and science debate over the merits of the nuclear fuel cycle. Local constituencies become deeply immersed in the complex debate whether the site is chosen through a technical site selection process or is a voluntary entry. Rural communities with candidate sites need to initially shift their focus away from this, often acrimonious, debate; instead, the first discussion priority for such rural communities should be to develop a dynamic vision of their own economic and environmental future. The second discussion priority should be to determine if the array of accompanying incentives and benefits hosting this facility would afford the community the opportunity for vision fulfillment. If so, total focus should, then, be given to understanding and resolving to the satisfaction of the constituents issues related to nuclear technology, isolation of radioactive materials, management of risk, storage and disposal facility need, perceived and actual risk, oversight and power sharing authority, engineered safety barriers, and public trust.

25681 (BNL–48991) **Bioremediation of soils, sludges, and materials contaminated with toxic metals or radionuclides.** Francis, A.J. Brookhaven National Lab., Upton, NY (United States). Apr 1993. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-930475–1: Innovative concepts technology fair, Austin, TX (United States), 22-23 Apr 1993). Order Number DE93014287. Source: OSTI; NTIS; GPO Dep.

Bioremediation stabilizes and reclaims radionuclide or toxic metal-contaminated materials, soils, sediments, or wastes; it then recovers the contaminating radionuclides and metals. Waste materials are stabilized and reduced in volume using anaerobic bacteria; or alternatively, materials are treated with citric acid before bioremediation begins. Photolysis is used after bioremediation to release radionuclides.

25682 (CONF-920866–7) **Current plans to characterize the design basis ground motion at the Yucca Mountain, Nevada Site.** Simecka, W.B. (USDOE Nevada Field Office, Las Vegas, NV (United States)); Grant, T.A.; Voegele, M.D.; Cline, K.M. Science Applications International Corp., Las Vegas, NV (United States); American Society of Civil Engineers, New York, NY (United States). 1992. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC08-87NV10576. From American Society of Civil Engineers (ASCE) symposium on dynamic analysis and design considerations, for high-level nuclear waste repositories; San Francisco, CA (United States); 19-20 Aug 1992. Order Number DE93013508. Source: OSTI; NTIS; INIS; GPO Dep.

A site at Yucca Mountain Nevada is currently being studied to assess its suitability as a potential host site for the nation's first commercial high level waste repository. The DOE has proposed a new methodology for determining design-basis ground motions that uses both deterministic and probabilistic methods. The role of the deterministic approach is primary. It provides the level of detail needed by design engineers in the characterization of ground motions. The probabilistic approach provides a logical structured procedure for integrating the range of possible earthquakes that contribute to the ground motion hazard at the site. In addition, probabilistic methods will be used as needed to provide input for the assessment of long-term repository performance. This paper discusses the local tectonic environment, potential seismic sources and their associated displacements and ground motions. It also discusses the approach to assessing the design basis earthquake for the surface and underground facilities, as well as selected examples of the use of this type of information in design activities.

25683 (CONF-930906–3) **Treatment of waste by the Molten Salt Oxidation process at the Oak Ridge National Laboratory.** Crosley, S.M. (Oak Ridge National Lab., TN (United States)); Lorenzo, D.K.; Van Cleve, J.E.; Gay, R.L.; Barclay, K.M.; Newcomb, J.C.; Yosim, S.J. Oak Ridge National Lab., TN (United States). [1993]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From '93 international conference on nuclear waste management and environmental remediation; Prague (Czech Republic); 5-11 Sep 1993. Order Number DE93007856. Source: OSTI; NTIS; INIS; GPO Dep.

The Molten Salt Oxidation (MSO) process has been under development by the Energy Technology Engineering Center (ETEC) to treat hazardous, radioactive, and mixed waste. Testing of the system was done on a number of wastes to demonstrate the technical

feasibility of the process. This testing included simulated intermediate level waste (ILW) from the Oak Ridge National Laboratory. The intermediate level waste stream consisted of a slurry of concentrated aqueous solutions of sodium hydroxide and sodium nitrate, with a small amount of miscellaneous combustible components (PVC, TBP, kerosene, and ion exchange resins). The purpose of these tests was to evaluate the destruction of the organics, evaporation of the water, and conversion of the hazardous salts (hydroxide and nitrate) to non-hazardous sodium carbonate. Results of the tests are discussed and analyzed, and the possibilities of applying the MSO process to different waste streams at ORNL in the future are explored.

25684 (DOE–93013923) **Status report on roadmap headquarters issue resolution activities.** USDOE Assistant Secretary for Environmental Restoration and Waste Management, Washington, DC (United States). 7 Apr 1993. 120p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93013923. Source: OSTI; NTIS; INIS; GPO Dep.

The Roadmap Project Office (RPO), under the Office of Planning (EM-14), continues to review headquarters (HQ) issues raised by the field in their roadmap documents. Currently, twenty-nine HQ issues are in the "resolution" process or are being defined for resolution. The resolution process involves an Environmental Restoration and Waste Management Program (EM) HQ person, the Action Officer (AO), as the leader in the resolution process. The RPO is responsible to EM-14 for reporting on the progress of issue resolution activities and also to provide contractor support to each Action Officer: the contractor support person is identifies as the Issue Resolution Facilitator (IF). Field contacts also are identified for each issue. This document provides current information on HQ issues actively in the "resolution" process or being defined for resolution. The issues are primarily institutional rather than technical and mainly involve regulatory, coordination, prioritization, policy and management concerns.

25685 (DOE/DP/00789–T272) **Test plan: Heated axisymmetric pillar.** Torres, T.M. Sandia National Labs., Albuquerque, NM (United States). Jun 1983. 266p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93012203. Source: OSTI; NTIS; GPO Dep.

The Heated Axisymmetric Pillar in situ test in room H is an intermediate step in validating numerical techniques for design and performance calculations for radioactive-waste repositories. Because the completely isolated cylindrically shaped pillar is centrally located in an annular drift and is two-dimensional or axisymmetric, numerical calculations to predict the pillar response can nearly duplicate the configuration. The axisymmetric approximation applies to both structural and thermal fields. Consequently, to a first approximation the adequacy of the constitutive model at elevated temperature for a large 10,180-ft ^{3} (950-m^3) in situ rock mass is being primarily explored in the test. Satisfactory agreement between measured and predicted response will aid in the confirmation that laboratory-generated constitutive parameters and models can be applied to large rock masses. The macrostratigraphy of clay seams, disseminated clay, anhydrite layers, and polyhalite contents, if any, will be well known because the entire pillar surface is exposed before the test. The surface of the pillar will be heated by an insulated blanket heater so as to increase its mean temperature by about 40°C in 3 years. Instruments will be installed to measure vertical and horizontal drift closures, deformations of the salt within the pillar and around the drift up to a distance of 50 ft (15.240 m) into the salt, and stresses (pressures) in the salt in the pillar and around the drift up to 50 ft (15.240 m) into the salt. Thermocouples will be installed to measure temperatures of the salt around the drift and pillar. Deformation and fracture of the pillar will be monitored by acoustic-emission triangulation. Also, fracture will be monitored by visual observations of the pillar surface at designated locations. Measurements will continue for at least 3 years.

25686 (DOE/DP/00789–T277) **Experimental plan for tracer testing in the Culebra Dolomite at the WIPP site: Revision A.** Beauheim, R.L.; Davies, P.B. Sandia National Labs., Albuquerque, NM (United States). 15 Oct 1992. 31p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93012208. Source: OSTI; NTIS; INIS; GPO Dep.

This Experimental Plan provides a conceptual description of a proposed series of tracer tests to be conducted in the Culebra Dolomite Member of the Rustler Formation at the WIPP site. The new tracer tests are intended to address deficiencies that have been identified both in the performance and interpretation of previously conducted tracer tests' Tracer tests were conducted at the H-2 hydropad in 1980, at the H-6 hydropad in 1981, 1982, and 1983, at the H-4 hydropad from 1982 to 1984, at the H-3 hydropad in 1984, and at the H-11 hydropad in 1988. These tests were all performed over the entire 7-m thickness of the Culebra and, therefore, provided no information on the effects of vertical heterogeneity within the Culebra on transport. In addition, each of the previous tracer tests provided data only from 1 to 3 flow paths, allowing calibration of interpretive models but not validation of those models. The tracer tests at the H-3, H-6, and H-11 hydropads have been interpreted using a double-porosity continuum model (SWIFT 11) in which advective transport occurs through a uniform network of fractures while diffusion of tracer from the fractures to the porosity in the rock matrix causes a physical retardation of the transport. External reviewers, particularly participants in the international INTRAVAL program, have suggested that alternative mechanisms, such as fracture channeling, could explain the observed physical retardation and have recommended that additional tracer tests be designed and performed to distinguish among these mechanisms. The previous tracer tests also provided no information on chemical-retardation processes within the Culebra, which have been shown through performance-assessment calculations to have a large impact on cumulative releases of radionuclides from the WIPP to the accessible environment.

25687 (DOE/EM–0089T-Rev.1) **DOE methods for evaluating environmental and waste management samples: Revision 1.** Goheen, S.C. (Pacific Northwest Lab., Richland, WA (United States)); McCulloch, M.; Thomas, B.L.; Riley, R.G.; Sklarew, D.S.; Mong, G.M.; Fadeff, S.K. (eds.). USDOE Assistant Secretary for Environmental Restoration and Waste Management, Washington, DC (United States); Pacific Northwest Lab., Richland, WA (United States). Mar 1993. 176p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (PNL–7722). Order Number DE93014591. Source: OSTI; NTIS; INIS; GPO Dep.

DOE Methods for Evaluating Environmental and Waste Management Samples (DOE Methods) provides applicable methods in use by. the US Department of Energy (DOE) laboratories for sampling and analyzing constituents of waste and environmental samples. The development of DOE Methods is supported by the Laboratory Management Division (LMD) of the DOE. This document contains chapters and methods that are proposed for use in evaluating components of DOE environmental and waste management samples. DOE Methods is a resource intended to support sampling and analytical activities that will aid in defining the type and breadth of contamination and thus determine the extent of environmental restoration or waste management actions needed, as defined by the DOE, the US Environmental Protection Agency (EPA), or others.

25688 (DOE/FTR–93012976) **Travel to the Envirotech Vienna 1992 conference in Vienna, Austria to obtain current information related to waste management activities and technologies: Foreign trip report, April 21–24, 1992.** Motes, B.G. EG and G Idaho, Inc., Idaho Falls, ID (United States). 22 Jun 1992. 23p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. Order Number DE93012976. Source: OSTI; NTIS (US Sales Only); GPO Dep.

During the conference, approximately 80 papers were presented in 12 technical sessions and one poster paper session. The papers were divided into the following subject areas: Waste minimization and avoidance; circular recycling processes; assessment, development and waste management perspectives; development and reduction of packaging; industrial wastes treatment; legislation and guidelines; detection, test methods, monitoring, and assessment of contaminated sites; site remediation; leachates; bioremediation of soils; surface and groundwater purification; and wastewater treatment. The comprehensive section of the report summarizes selected papers grouped by country. The titles of other papers

presented are also provided by country. In addition, pertinent discussions with attendees are incorporated. In summary, the US is the world leader in waste management, including overall technology. A number of other more industrialized countries have established waste management programs and are aggressively addressing their waste management problems. The former soviet block countries are only initiating their waste management programs and are seeking foreign support and technology. A number of foreign countries have or are developing innovative technologies potentially applicable to site remediation in the US.

25689 (DOE/FTR–93013123) **Travel to Bristol, England to observe "proof-of-principle" experiments for nitric acid recycle and nitrate destruction, review progress on contracted work, and the project schedule status: Foreign trip report, July 25–30, 1992.** Lehmkuhl, G.D. EG and G Rocky Flats, Inc., Golden, CO (United States). Rocky Flats Plant. 28 Aug 1992. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC34-90DP62349. Order Number DE93013123. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The proof-of-principle experiments for nitric acid recycle and nitrate destruction were successfully run at the Bradtec Limited laboratory in Bristol, England. A spike of plutonium plus americium was added to the feed stream to trace actinide movement-and distribution. While experimental results are not complete at this time, it has been shown that the Bradtec processes are definitely applicable to processing of wastes at Rocky Flats plant and other DOE sites. The Bradtec processes are, however, presently far from being ready for production use. It is recommended that further development be undertaken to tailor the processes for specific waste streams at DOE sites and to scale up the equipment for production uses. Bradtec has committed to submitting their final report draft to Rocky Flats by September 18, 1992. Rocky Flats review comments will be sent to Bradtec for consideration prior to issuing the final version of the report. The delay of the final report beyond the originally scheduled date (18 August 1992) is due to a temporary shut down of the Bradtec experimental laboratory for ventillation system duct remediation. This will cause a delay in chemical analyses of experimental solutions.

25690 (DOE-HMIP-RR–92.111) **The Nirex Sellafield site investigation: the role of geophysical interpretation.** Muir Wood, R.; Woo, G.; MacMillan, G. BEQE Ltd., Warrington (United Kingdom). 1992. [121p.] Sponsored by Department of the Environment, London (United Kingdom). Her Majesty's Inspectorate of Pollution. Contract PECD-7/9/620;55-01-R-01. Order Number DE93631586. Source: OSTI; NTIS (US Sales Only); INIS.

This report reviews the methods by which geophysical data are interpreted, and used to characterize the 3-D geology of a site for potential storage of radioactive waste. The report focuses on the NIREX site investigation at Sellafield, for which geophysical observations provide a significant component of the structural geological understanding. In outlining the basic technical principles of seismic data processing and interpretation, and borehole logging, an attempt has been made to identify errors, uncertainties, and the implicit use of expert judgement. To enhance the reliability of a radiological probabilistic risk assessment, recommendations are proposed for independent use of the primary NIREX geophysical site investigation data in characterizing the site geology. These recommendations include quantitative procedures for undertaking an uncertainty audit using a combination of statistical analysis and expert judgement. (author).

25691 (DOE/LLW–165) **Low-level radioactive waste disposal facility fee schedules.** Smith, P. EG and G Idaho, Inc., Idaho Falls, ID (United States); Rogers and Associates Engineering Corp., Salt Lake City, UT (United States). Apr 1993. 76p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. Order Number DE93013744. Source: OSTI; NTIS; INIS; GPO Dep.

In the 1990's and beyond, new low-level radioactive waste (LLW) disposal facilities will be developed by States and compact regions. These disposal facilities will differ significantly from the existing facilities in a number of ways. One of these ways may be the fee schedule used to determine how much is charged each of the LLW generators to dispose of its wastes. This report reviews the general concept of fee schedules. There are an infinite number of combinations of the potential elements for a fee schedule, but the report focuses on four kinds of schedules: volume-based schedules, activity-based schedules, annual use fees, and cost allocation schedules. The choice of which elements to use and the structure of the schedule will be determined by the facility operator or its regulatory authority. This document is intended to assist them in understanding the choices available and the potential impacts of the schedule that they select.

25692 (DOE/METC/C–93/7063) **Innovative technologies for recycling and reusing radioactively contaminated materials from DOE facilities.** Bossart, S.J. (USDOE Morgantown Energy Technology Center, WV (United States)); Hyde, J. USDOE Morgantown Energy Technology Center, WV (United States). [1993]. 16p. Sponsored by USDOE, Washington, DC (United States). (CONF-930523–8: 18. National Association of Environmental Professionals (NAEP) annual conference on current and future priorities for environmental management, Raleigh, NC (United States), 24-26 May 1993). Order Number DE93015579. Source: OSTI; NTIS; INIS; GPO Dep.

Through award of ten contracts under the solicitation, DOE is continuing efforts to develop innovative technologies for decontamination and recycling or reusing of process equipment, scrap metal, and concrete. These ten technologies are describe briefly in this report. There is great economic incentive for recycling or reusing materials generated during D&D of DOE's facilities. If successfully developed, these superior technologies will enable DOE to clean its facilities by 2019. These technologies will also generate a reusable or recyclable product, while achieving D&D in less time at lower cost with reduced health and safety risks to the workers, the public and the environment.

25693 (DOE/NBM–1100-Vol.5) **US Department of Energy interim mixed waste inventory report: Waste streams, treatment capacities and technologies: Volume 5, Site specific-Tennessee through Washington.** USDOE Office of Environmental Restoration and Waste Management, Washington, DC (United States); Sandia National Labs., Albuquerque, NM (United States); Brookhaven National Lab., Upton, NY (United States); EG and G Idaho, Inc., Idaho Falls, ID (United States). Apr 1993. 752p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789 ;AC06-76RL01830 ;AC07-76ID01570. Contract AF-6871. Order Number DE93012100. Source: OSTI; NTIS; INIS; GPO Dep.

The Department of Energy (DOE) has prepared this report to provide an inventory of its mixed wastes and treatment capacities and technologies in response to Section 105(a) of the Federal Facility Compliance Act (FFCAct) of 1992 (pub. L. No. 102-386). As required by the FFCAct-1992, this report provides site-specific information on DOE's mixed waste streams and a general review of available and planned treatment facilities for mixed wastes for the following sites: ORNL; Y-12 Plant; K-25 Plant; Pantex Plant; Norfolk Naval Shipyard; Hanford Site; and Puget Sound Naval Shipyard.

25694 (DOE/NV/10872–T57) **Heat pipe effect in porous medium.** Joseph, M. Nevada Univ., Las Vegas, NV (United States). Dept. of Civil and Environmental Engineering. Dec 1992. 97p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC08-90NV10872. Order Number DE93014243. Source: OSTI; NTIS; INIS; GPO Dep.

In this thesis a parametric study of the thermal and hydrologic characteristics of the fractured porous tuffs at Yucca Mountain, Nevada was conducted. The effects of different fracture and matrix properties including permeability, thermal conductivity, specific heat, porosity, and tortuosity on heat pipe performance in the vicinity of the waste package were observed. Computer simulations were carried out using TOUGH code on a Cray YMP-2 supercomputer. None of the fracture parameters affected the heat pipe performance except the mobility of the liquid in the fracture. Matrix permeability and thermal conductivity were found to have significant effect on the heat pipe performance. The effect of mass injection was studied for liquid water and air injected at the fracture boundary. A high rate of mass injection was required to produce any

effect on the heat pipe. The fracture-matrix equilibrium is influenced by the matrix permeability and the matrix thermal conductivity.

25695 (DOE/OR–01-1100-D2) **RCRA closure plan for the Bear Creek Burial Grounds B Area and Walk- In Pits at the Oak Ridge Y-12 Plant, Oak Ridge, Tennessee.** Oak Ridge Y-12 Plant, TN (United States). Jan 1993. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. (Y/ER–53-D2). Order Number DE93013201. Source: OSTI; NTIS; INIS; GPO Dep.

In June 1987, the RCRA Closure/Postclosure Plan for the Bear Creek Burial Grounds (BCBG) was submitted to the Tennessee Department of Environment and Conservation (TDEC) for review and approval. TDEC modified and issued the plan approved on September 30, 1987. Subsequently, this plan was modified again and approved as Y/TS-395, Revised RCRA Closure Plan for the Bear Creek Burial Grounds (February 29, 1988). Y/TS-395 was initially intended to apply to A Area, C-West, B Area, and the Walk-In Pits of BCBG. However, a concept was developed to include the B Area (non-RCRA regulated) in the Walk-In Pits so that both areas would be closed under one cap. This approach included a tremendous amount of site preparation with an underlying stabilization base of 16 ft of sand for blast protection. The plan was presented to the state of Tennessee on March 8, 1990, and the Department of Energy was requested to review other unique alternatives to close the site. This amended closure plan goes further to include inspection and maintenance criteria along with other details.

25696 (DOE/OR–1054-D2) **Phase 2 Sampling Plan for Chestnut Ridge Operable Unit 2 (Filled Coal Ash Pond/Upper McCoy Branch) at the Oak Ridge Y-12 Plant, Oak Ridge, Tennessee: Environment Restoration Program.** Oak Ridge Y-12 Plant, TN (United States); CDM Federal Programs Corp., Oak Ridge, TN (United States). Jan 1993. 268p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OS21400. (Y/ER–42-D2). Order Number DE93013202. Source: OSTI; NTIS; INIS; GPO Dep.

CDM Federal Programs Corporation (CDM Federal) was contracted by Energy Systems to prepare a Phase II Sampling Plan to describe the field investigation work necessary to address regulatory agency review comments on the Remedial Investigation of the Filled Coal Ash Pond (FCAP)/Upper McCoy Branch, Chestnut Ridge Operable Unit 2 at the Y-12 Plant, conducted by CH2M Hill in 1990. The scope and approach of the field investigation described in this plan specifically focus on deficiencies noted by the regulators in discussions at the comment resolution meeting of May 8, 1992, in Oak Ridge, Tennessee. This Phase II Sampling Plan includes a field sampling plan, a field and laboratory quality assurance project plan, a health and safety plan, a waste management plan, and appendixes providing an update to the applicable or relevant and appropriate requirements for this site and field and laboratory testing methods and procedures.

25697 (DOE/RW/00134–T2) **Yucca Mountain Site Characterization Project Technical Data Catalog.** USDOE Yucca Mountain Site Characterization Project Office, Las Vegas, NV (United States). 31 Dec 1992. 246p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC01-91RW00134. Order Number DE93014510. Source: OSTI; NTIS; INIS; GPO Dep.

The June 1, 1985, Department of Energy (DOE)/Nuclear, Regulatory Commission (NRC) Site-Specific Procedural Agreement for Geologic Repository Site Investigation and Characterization Program requires the DOE to develop and maintain a catalog of data which will be updated and provided to the NRC at least quarterly. This catalog is to include a description of the data; the time (date), place, and method of acquisition; and where it may be examined. The Yucca Mountain Site Characterization Project (YMP) Technical Data Catalog is published and distributed in accordance with the requirements of the Site-Specific Agreement. The YMP Technical Data Catalog is a report based on reference information contained in the YMP Automated Technical Data Tracking System (ATDT). The reference information is provided by Participants for data acquired or developed in support of the YMP. The Technical Data Catalog is updated quarterly and published in the month following the end of each quarter. Each new publication of the Technical Data Catalog supersedes the previous edition.

25698 (DOE/RW/00134–T4) **A comparative application of the Repository Integration Program (RIP) to Total System Performance Assessment, 1991.** INTERA, Inc., Las Vegas, NV (United States). 16 Jul 1993. 276p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC01-91RW00134. Order Number DE93017134. Source: OSTI; NTIS; INIS; GPO Dep.

During Fiscal Year (FY) 1991 and FY 1992, Sandia National Laboratory and Battelle Pacific Northwest Laboratory were assigned the responsibility to generate initial Total System Performance Assessments (TSPAs) of the Yucca Mountain site. The analyses performed by these organizations (called TSPA-1991) are reported in Barnard et al(1992) and Eslinger et al. (1993). During this same time period, Golder Associates Inc. was assigned the task of generating a model capable of analyzing the total system performance of a high-level radioactive waste repository. The developed model, called Repository Integration Program (RIP), is documented in Kossik and Hachey (1993), Miller et al. (1993), and Golder Associates Inc. (1993). In FY 1993, the Civilian Radioactive Waste Management System Contractor was assigned the responsibility to plan, coordinate, and contribute to the second iteration of TSPA-2. Prior to initiating the next TSPA iteration, it was decided that it would be valuable to evaluate the applicability of RIP for use in this iteration. Therefore, analyses were conducted to compare the results generated by RIP to those reported in TSPA-1991. In particular, the aim was to generate a RIP input data set as equivalent as possible to that documented in Barnard et al. (1992) and to analyze the total system performance (as well as the performance of the individual subsystem components of the waste package/Engineered Barrier System (EBS), unsaturated gaseous flow and transport, unsaturated aqueous flow and transport, saturated flow and transport, and disruptive processes/events). The performance measure for comparison with the results of TSPA-1991 is the cumulative release of radionuclides to the accessible environment over a 10,000-year period following closure normalized to the US Environmental Protection Agency (EPA) release limits specified in 40 CFR 191.

25699 (DOE/WIPP–92-007) **Waste Isolation Pilot Plant: Site environmental report for calendar year 1991.** Westinghouse Electric Corp., Carlsbad, NM (United States). Waste Isolation Div. [1991]. 1503p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-86AL31950. Order Number DE93015034. Source: OSTI; NTIS; INIS; GPO Dep.

The US Department of Energy (DOE) Waste Isolation Pilot Plant (WIPP) Operational Environmental Monitoring Plan (OEMP) monitors a comprehensive set of parameters in order to detect any potential environmental impacts and establish baselines for future quantitative environmental impact evaluations. Surface water and groundwater, air, soil, and biotics are measured for background radiation. Nonradiological environmental monitoring activities include air quality, water quality, soil properties, meteorological, and the status of the local biological community. Ecological studies focus on the immediate area surrounding the site with emphasis on the salt storage pile, whereas baseline radiological surveillance covers a broader geographic area including nearby ranches, villages, and cities. Since the WIPP is still in a preoperational state, and no waste has been received; certain elements required by DOE Order 5400.1 are not presented in this report. The most significant addition to the 1991 report is the inclusion of the first four appendices, the Radiological Baseline Program (DOE/WIPP 92-037), the Salt Impact Studies (DOE/WIPP 92-038), the Disturbed Land Reclamation Techniques (DOE/WIPP 92-039), and the Background Water Characterization for the WIPP (DOE/WIPP 92-013). These appendices are independently published and available to interested parties by the DOE reference number. These summaries will not be published in future ASER'S. They will, however, be referenced as a basis for evaluating similar data collected during the Test and subsequent Operational phases of the WIPP.

25700 (DOE/WIPP–93-012) **WIPP supplementary roof support system Room 1, Panel 1: Geotechnical field data analysis report.** Westinghouse Electric Corp., Carlsbad, NM (United States). Waste Isolation Div. Mar 1993. 61p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-86AL31950. Order Number DE93014889. Source: OSTI; NTIS; INIS; GPO Dep.

The design of the Room 1, Panel 1, supplementary roof support system was finalized in September 1991, and the system successfully installed in the test bin area between the bulkheads by December 1991. Simultaneously with the support system installation, existing monitoring system was upgraded to meet the needs of the installed roof support. This included extensometers, closure stations, rockbolt load cells as well as survey measurements of roof sag and floor lift. A Project Control Group (PCG) was established in order to monitor room and support system performance. Weekly meetings of the PCG were held to review all monitored data against criteria set in the initial design, and to modify these where necessary. Records of these meetings have been kept, with copies of all data summaries and action notes. These data records are maintained in the Engineering data files. After more than ten months of monitoring and reviewing experience, several modifications have been made both to the way data has been reported as well as to the load adjustment criteria. The support system has performed as expected in the design, with no signs of instability developing considering the rates of roof deformation, the rock bolt loads and the observed fracture behavior in the roof. This is particularly true of the horizon in which the rockbolt anchors are located, the most critical part of the design. The distribution of load build-up, throughout the 286 rockbolt load cells installed, in the Room 1 has been found satisfactory, and the load increases as evaluated by the PCG on a weekly basis have been within the acceptable range. The minimum life of the installed support system is estimated at 15 years based on the highest roof expansion rate experienced to date. This report provides analysis of geotechnical field data collected up to December 1992.

25701 (DPST–74-485) **Cost-benefit evaluation of compaction for solid TRU wastes.** Hootman, H.E. Du Pont de Nemours (E.I.) and Co., Aiken, SC (United States). Savannah River Lab. 18 Sep 1974. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. (SR/H–591). Order Number DE93016190. Source: OSTI; NTIS (US Sales Only); GPO Dep.

A study was made to evaluate costs/benefits that might result from mechanical compaction of solid transuranic wastes at Savannah River. The possible incentive for compaction is to reduce waste container costs during the interim before storage in an engineered facility. Results of the evaluation show that compaction of SRP-SRL wastes would increase the cost of present alpha waste storage. Annual operating costs to compact alpha waste would exceed the annual savings in container costs. In addition, the capital cost of the compaction facility, $200,000 to $1 million depending upon availability of space in an existing building, would not be recovered. This study is based on the assumption that compaction per se does not advance the waste to a form suitable for centuries long storage in an engineered facility.

25702 (EGG-ERTP–10647) **Summary report of project SIREN (Search, Intercept, Retrieve, Expulsion, Nuclear).** Buden, D. EG and G Idaho, Inc., Idaho Falls, ID (United States). Dec 1992. 30p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. Order Number DE93012332. Source: OSTI; NTIS; INIS; GPO Dep.

Project SIREN (Search, Intercept, Retrieve, Expulsion, Nuclear) has evaluated the technologies and operational strategies needed to rendezvous with and capture aerospace radioactive materials (e.g., a distressed or spent space reactor core) before such materials can reenter the terrestrial atmosphere and to move these captured materials to a space destination for proper disposal. The use of systems external to a satellite allows multiple attempts to prevent the nuclear materials from reentering the atmosphere. SIREN also has investigated means to prevent the breakup of nuclear-powered systems already in space. The SIREN project has determined that external means can be used reliably to prevent nuclear materials from reentering the terrestrial environment, prepared a computer model that can be used to evaluate the means to dispose of radioactive materials, assessed the hazards from existing nuclear power systems in space, and in discussions with Russian Federation representatives determined interest in joint activities in this area.

25703 (EGG-FSP–10603) **Experimental Tritium Cleanup System availability analysis from 1984 to 1992.** Cadwallader, L.C. (EG and G Idaho, Inc., Idaho Falls, ID (United States)); Taylor, G.L. EG and G Idaho, Inc., Idaho Falls, ID (United States). May 1993. 66p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. Order Number DE93016482. Source: OSTI; NTIS; INIS; GPO Dep.

This report gives the availability percentage of the Experimental Tritium Cleanup System (ETC) at the Tritium Systems Test Assembly (TSTA), which is a fusion research and technology facility at the Los Alamos National Laboratory. The component failure reports, the numbers of components, and operating times or demands are all given in this report. Sample calculations of the failure rates obtained from these data are given in the appendices. While future fusion experiments might use different or more advanced means to detritiate room air, the analysis of this system gives a data point for an actual detritiation system. Such a data point can be extrapolated for comparison with fault tree results on system designs, or can be used in a Bayesian failure rate analysis for estimating reliability of a new type of system. The nine years of testing operations on TSTA's ETC result in a reasonable average availability value of 92% for the maximal tritium release event. The failure rates for new systems are expected to be lower than for the TSTA ETC, since improvements will be made in the design of the room air detritiation system based on the TSTA system experiences. Nonetheless, these TSTA data should be useful for future fusion reactor design work and safety assessment tasks.

25704 (EGG-M–92558) **Application of lysimeter data as input to performance assessment evaluations of a low-level waste disposal facility.** McConnell, J.W. Jr. (EG and G Idaho, Inc., Idaho Falls, ID (United States)); Rogers, R.D.; Sullivan, T.M.; Jastrow, J .D.; Hicks, D.S.; Brey, R.R. EG and G Idaho, Inc., Idaho Falls, ID (United States). [1993]. 18p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC07-76ID01570. (CONF-930205–63: Waste management '93, Tucson, AZ (United States), 28 Feb - 4 mar 1993). Order Number DE93013662. Source: OSTI; NTIS; INIS; GPO Dep.

The Field Lysimeter Investigations: Low-Level Waste Data Base Development Program is obtaining information on the performance of radioactive waste in a disposal environment. Waste forms fabricated using ion-exchange resins from EPICOR-II are being tested to develop a low-level waste data base and to obtain information on survivability of waste forms in a disposal environment. The program includes examining radionuclide releases from waste forms in the first seven years of sampling. Also, lysimeter data are applied to performance assessment source term models, and initial results from use of data in two models are being studied.

25705 (EGG-WTD–10550) **Technical and regulatory review of the Rover nuclear fuel process for use on Fort St. Vrain fuel.** Hertzler, T. (Science Applications International Corp., Idaho Falls, ID (United States)). EG and G Idaho, Inc., Idaho Falls, ID (United States); Science Applications International Corp., Idaho Falls, ID (United States). Feb 1993. 71p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. Order Number DE93012187. Source: OSTI; NTIS; INIS; GPO Dep.

This report describes the results of an analysis for processing and final disposal of Fort St. Vrain (FSV) irradiated fuel in Rover-type equipment or technologies. This analysis includes an evaluation of the current Rover equipment status and the applicability of this technology in processing FSV fuel. The analyses are based on the physical characteristics of the FSV fuel and processing capabilities of the Rover equipment. Alternate FSV fuel disposal options are also considered including fuel-rod removal from the block, disposal of the empty block, or disposal of the entire fuel-containing block. The results of these analyses document that the current Rover hardware is not operable for any purpose, and any effort to restart this hardware will require extensive modifications and re-evaluation. However, various aspects of the Rover technology, such as the successful fluid-bed burner design, can be applied with modification to FSV fuel processing. The current regulatory climate and technical knowledge are not adequately defined to allow a complete analysis and conclusion with respect to the disposal of intact fuel blocks with or without the fuel rods removed.

The primary unknowns include the various aspects of fuel-rod removal from the block, concentration of radionuclides remaining in the graphite block after rod removal, and acceptability of carbon in the form of graphite in a high level waste repository.

25706 (ENEA-RT-AMB–91-15) **Option of sea-dumping and presentation of CRESP's results.** Cigna, A. ENEA, Saluggia (Italy). Centro Ricerche Energia - Area Energia Ambiente e Salute. Jul 1991. 10p. (CONF-901231–1: IRPA regional congress: sea dumping of low level radioactive waste-scientific radiation protection considerations, Paris (France), 11-12 Dec 1990; RT/AMB–91-15). Order Number DE93799303. Source: OSTI; NTIS (US Sales Only); INIS.

In Italy, sea-dumping was practised from 1946 until the mid-1960's on a national basis. Since 1967 it has been practised by a number of European countries under an international arrangement managed by the NEA-OECD. In 1983, sea-dumping was suspended after a resolution of the London Dumping Convention, and the moratorium is still in effect. The Co-ordinated Research and Environmental Surveillance Programme relevant to sea disposal of radioactive wastes (CRESP) was created by the NEA in 1981. CRESP developed a suitable data base and models to estimate doses to man and marine organisms with sufficient accuracy for the purpose of site suitability assessment. In order to improve the scientific data base and for a further refinement of radiological assessment, a more comprehensive work on the risks associated with sea dumping is being carried out. The results obtained to date are summarized in this paper and the future objectives and scope are also reported.

25707 (ETDE-IT–93-156) **Site restoration activity at ENEA Trisaia center.** Di Pace, L.; Pastore, C.; Ragazzo, G.; Risoluti, P. ENEA, Casaccia (Italy). 1992. 6p. (CONF-920851–95: Spectrum '92: nuclear and hazardous waste management international topical meeting, Boise, ID (United States), 23-27 Aug 1992). Order Number DE93799226. Source: OSTI; NTIS (US Sales Only); INIS.

During the operations of the ITREC reprocessing pilot plant at the ENEA (Italian Agency for Energy, New Technologies and the Environment) Trisaia Center (Southern Italy), about 1,000 cubic meters of solid LLW were produced and stored on the site. Some 600 cubic meters of these wastes were buried in a suitable area of the site. In 1989, restoration activities began at the site. The wastes were first retrieved from the burial site and conditioned by supercompaction and cementation. During the excavation operations, about 1,300 cubic meters of contaminated soil were also collected in drums. This paper describes the operations carried out for conditioning the solid LLW as well as the disposal concept envisaged for the contaminated soil. A 20,000 kN press was used to supercompact about 2,800 drums of recovered wastes in 400 lt overpacks suitable for final disposal. A volume reduction factor of 3.5 was achieved in the operations. About 50% of the contaminated soil, with gamma specific activity lower than 7.4 Bq/g, is planned to be disposed of in the excavated area confined by a high density polyethylene (HDPE) sheets, with a further barrier made of bentonite and clay. The remaining soil will be placed in large containers specially designed for long term outdoor storage. The system is being evaluated by the Safety Authority. A decision is expected by the end of 1992.

25708 (EUR–14043/4) **Assessment of management alternatives for LWR wastes. Volume 4. Description of a Belgian scenario for PWR waste.** Crustin, J. (Belgatom SA, Brussels (Belgium)); Glibert, R. Commission of the European Communities, Luxembourg (Luxembourg). 1993. [131p.] Contract FI1W/0124-B. Source: OSTI; NTIS (US Sales Only); INIS.

This report deals with the description of a management route for PWR waste relying to a certain extent on Belgian practices in this particular area. This description, which aims at providing input data for subsequent cost evaluation, includes all management steps which are usually implemented for solid, liquid and gaseous wastes from their production up to the interim storage of the final waste products. This study is part of an overall theoretical exercise aimed at evaluating a selection of management routes for LWR waste based on economical and radiological criteria.

25709 (EUR–14043/8) **Assessment of management alternatives for LWR wastes. Volume 8. Cost and radiological impact associated with near-surface disposal of reactor waste (Spanish concept).** Alamo Berna, S.; Sanchez Delgado, N. Commission of the European Communities, Luxembourg (Luxembourg). 1993. [53p.] Contract FI1W/127-E. Source: OSTI; NTIS (US Sales Only); INIS.

This report deals with the determination of the cost and the radiological impact associated with a near-surface disposal site (Spanish concept) for low and medium-level radioactive waste generated during operation of a 20 GWe nuclear park composed of LWRs for 30 years. This study is part of an overall theoretical exercise aimed at evaluating a selection of management routes for LWR waste based on economical and radiological criteria.

25710 (EUR–14232) **Evaluation of management alternatives for LWR hulls and caps.** Chaudon, L. (CEA Centre d'Etudes de la Vallee du Rhone, 30 - Marcoule (France). Dept. des Procedes de Retraitement); Klein, M.; Mehling, O.; Cecille, L.; Thiels, G.; Kowa, S. Commission of the European Communities, Luxembourg (Luxembourg). 1993. [293p.] Contract FI 1W-0260-F. Source: OSTI; NTIS (US Sales Only); INIS.

Hulls and caps resulting from the reprocessing of LWR spent fuels represent one of the major sources of alpha-bearing solid waste generated during the nuclear fuel cycle. The Commission of the European Communities has undertaken considerable R and D efforts on the development of advanced treatment and conditioning methods for this type of waste. In view of the encouraging results achieved, the Commission launched a theoretical assessment study on cladding waste management. Six practical or potential schemes were identified and elaborated: direct cementation, decontamination prior to cementation, rolling before cementation, rolling followed by embedding in graphite, compaction, and melting in a cold crucible. The economic aspects of each management option were also investigated. This included the assessment of the plant (treatment, conditioning and interim storage), transport and disposal costs. Further consideration will be required to define the best management option for 'cap' wastes. Transport and disposal costs will also require further analysis from an industrial standpoint.

25711 (IAEA-TECDOC–700, pp. 81-86) **A modular implementation of G2 on a solvent extraction process.** Robinson, G. (Salford Univ. Business Services Ltd, Salford (United Kingdom)); Mullhi, J.S.; Lamb, N. International Atomic Energy Agency, Vienna (Austria). Apr 1993. (CONF-9209356–: Specialists meeting/workshop on the potential of knowledge based systems in nuclear installations, Erlangen (Germany), 21-25 Sep 1992). In *The potential of knowledge based systems in nuclear installations: Report of a specialists' meeting/workshop held in Erlangen, Germany, 21-25 September 1992.* [97p.] Order Number DE93629675. Source: OSTI; NTIS (US Sales Only); INIS.

The application of G2 to a solvent extraction process is presented, covering topics throughout the development cycle from conceptual design and development to implementation. Attention is paid to issues surrounding modular development within the G2 environment and the possibilities for cooperative team-based approaches. A brief description of the application architecture introduces two example modules, spc.kl a knowledge library concerned with providing statistical process control, and proc.kl a knowledge library for the implementation of plant operating procedures. (author). 4 figs.

25712 (INIS-mf–12758, pp. 381-389) **Description of project for pretreatment and storage of wastes of L.P.R. (Radiochemical Processes Laboratory).** Doval, J.C.F. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina). Gerencia de Procesos Quimicos); Mehlich, A.M.; Quilici, D.F. Asociacion Argentina de Tecnologia Nuclear, Buenos Aires (Argentina). 1987. [735p.] (In Spanish). (CONF-8711355–: 15. scientific meeting and 4th Latin American meeting and 1st sessions on nuclear power plants, San Carlos de Bariloche (Argentina), 2-6 Nov 1987). In *Proceedings of the fifteenth scientific meeting; fourth Latin American meeting; first sessions on nuclear power plants.* Order Number DE91003052. Source: OSTI; NTIS (US Sales Only); INIS.

The aim of the project is to allow the start up and operation of LPR (Radiochemical Processes Laboratory) as part of the intended

activities in the plant. In this paper, the pretreatment and storage of liquid wastes generated at the LPR are described. The pretreatment section will be set up inside the shielded cells already existent in the LPR, where a previous concentration through the evaporation of liquid wastes will take place. The storage section has to be constructed on purpose in order to temporarily store the concentrates. The cells of transference and preconditioning of solid wastes are also described. These cells will be mounted inside the building, allowing the handling of radioactive solids generated as effluents during the reprocessing plan. In the description, the use of non conventional materials for the boiler making and the construction of cells is specially mentioned. (Author).

25713 (INIS-mf–12758, pp. 370-374) **Diffusion of actinides in salt and vitreous-salt matrix interaction.** Dyment, F. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina). Dept. de Materiales); Matzke, H. Asociacion Argentina de Tecnologia Nuclear, Buenos Aires (Argentina). 1987. [735p.] (In Spanish). (CONF-8711355–: 15. scientific meeting and 4th Latin American meeting and 1st sessions on nuclear power plants, San Carlos de Bariloche (Argentina), 2-6 Nov 1987). In *Proceedings of the fifteenth scientific meeting; fourth Latin American meeting; first sessions on nuclear power plants.* Order Number DE91003052. Source: OSTI; NTIS (US Sales Only); INIS.

The results obtained for the Rb diffusion in glasses designed to contain high level radioactive wastes, are presented. The glasses studied: VG 98/12 (VG = Versuchsglas) used as base and Gp 98/12 (Gp = Glasprodukt) similar to the previous ones, but with the aggregation of simulated fission products oxides, corrosion products and UO_2, were developed at the Institute fur Nuclear Entsorgung, Kernforschungzentrum, KfK, Germany. Such results were compared with those obtained for Cs and Na diffusion in the same glasses. The damage effect produced by irradiation in Rb and Cs implantation on both diffusion is analyzed, comparing the diffusion measurements performed from other methods which do not infer damage irradiation. The effect of 'alkali mixture' on their mobility is analyzed. In single alkaline glasses, of the $(1 - x)A'_2O - xA''_2O - nSiO_2$ type (A' and A" are two alkaline elements and $n \approx 3$ to 5), the gradual substitution of an alkaline ion for another one decreases significantly the auto diffusion coefficient of the replaced ion, increasing the activation enthalpy. The opposite occurs with the other ion. In the case of much more complex glasses which will be used to store radioactive wastes, the question is if by effect of Na-contents variation -due to irradiation damage effects, diffusion in thermal gradients or leaching- may significantly change the mobility of the other alkaline ions: Rb and Cs, particularly Cs^{137}. (Author).

25714 (INIS-mf–12758, pp. 375-380) **Treatment of radioactive wastes containing plutonium.** Orlando, O.S. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina). Dept. de Combustibles Nucleares); Aparicio, G.; Greco, L.; Orosco, E.H.; Cassaniti, P.; Salguero, D.; Toubes, B.; Perez, A.E.; Menghini, J.E.; Esteban, A.; Adelfang, P. Asociacion Argentina de Tecnologia Nuclear, Buenos Aires (Argentina). 1987. [735p.] (In Spanish). (CONF-8711355–: 15. scientific meeting and 4th Latin American meeting and 1st sessions on nuclear power plants, San Carlos de Bariloche (Argentina), 2-6 Nov 1987). In *Proceedings of the fifteenth scientific meeting; fourth Latin American meeting; first sessions on nuclear power plants.* Order Number DE91003052. Source: OSTI; NTIS (US Sales Only); INIS.

The radioactive wastes generated in the process of manufacture and control of experimental fuel rods of mixed oxides, $(U,Pu)O_2$, require an specific treatment due to the plutonium content. The composition of liquid wastes, mostly arising from chemical checks, is variable. The salt content, the acidity, and the plutonium and uranium content are different, which makes necessary a chemical treatment before the inclusion in concrete. The solid waste, such as neoprene gloves, PVC sleeves, filter paper, disposable or broken laboratory material, etc. are also included in concrete. In this report the methods used to dispose of wastes at Alpha Facility are described. With regard to the liquid wastes, the glove box built to process them is detailed, as well as the applied chemical treatment, including neutralization, filtration and later solidification. As for the solid wastes, it is described the cementation method consisting in introducing them into an expanded metal matrix, of the basket type, that contains as a concentric drum of 200 liter capacity which is smaller than the matrix, and the filling with wet cement mortar. (Author).

25715 (INIS-mf–13544, pp. 121-128) **Radiation deactivations of the long-life lived radioactive wastes with the help of median energy protons.** Zelenskij, V.F. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk (Russian Federation). Fiziko-Ehnergeticheskij Inst.); Neklyudov, I.M.; Ozhigov, L.S. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 5.* [232p.] Order Number DE93630453. Source: OSTI; NTIS (US Sales Only); INIS.

Specific energy expenses for one ^{137}Cs atom transmutation using 10-100 MeV protons, full absorption targets and targets which depths for any energy correspond to 10, 50, 100, 200 and 400 MeV proton energy losses were calculated. The obtained results show that there exists an optimal proton energy in this range for which a maximum transmutation level is obtained and this level is nearly the same as for 1 GeV protons. This indicates that a proton accelerator can be used for decontamination of nuclear power wastes. 5 refs.; 6 figs. (J.P.).

25716 (IPEN-PUB–371) **Characterization of wastes from fission ^{99} Mo production.** Endo, L.S.; Dellamano, J.C. Instituto de Pesquisas Energeticas e Nucleares (IPEN), Sao Paulo, SP (Brazil). Jul 1992. [41p.] (In Portuguese). Order Number DE93629784. Source: OSTI; NTIS (US Sales Only); INIS.

This work is a preliminary study on waste-streams generated in a fission ^{99} Mo production plant, their characterization and quantification. The study is based on a plant whose ^{99} Mo production process is the alkaline dissolution of U-target. The target is made of 1 g of enriched ^{235} U, therefore most of radionuclides present in the waste-streams are fission products. All the radionuclides inventories were estimated based on ORIGEN-2 Code. The characterization was done as a primary stage for the establishment of waste management plan, which should be subject for further study. (author).

25717 (IPEN-PUB–372) **Radioisotope content of wastes generated in ^{99} Mo production.** Vicente, R.; Dellamano, J.C.; Endo, L.S. Instituto de Pesquisas Energeticas e Nucleares (IPEN), Sao Paulo, SP (Brazil). Jul 1992. [93p.] (In Portuguese). Order Number DE93629783. Source: OSTI; NTIS (US Sales Only); INIS.

Many radioactive waste streams arise in the production of ^{99} Mo, each one with a fraction of the initial radioactive content of the irradiated uranium target. Eight relevant waste streams were identified - four liquid wastes, three solid wastes and one gaseous waste stream, which upon filtration constitutes another solid waste stream. The fractions of the elements initially present in the targets that are present in each stream were determined previously. In this report, the activity decay and the activity buildup in the liquid storage tanks and in the dry solid storages are mathematically modeled so that the waste activity after one year of radioisotope production can be estimated. The activities present in each drum of immobilized or encapsulated waste, generated upon treatment of those eight waste streams, are also calculated assuming that the drums will conform to type A 1 packages for the transportation of radioactive materials. (author).

25718 (IPEN-PUB–375) **Recovering of thorium contained in wastes from Thorium Purification Plant.** Brandao Filho, D.; Hespanhol, E.C.B.; Baba, S.; Miranda, L.E.T.; Araujo, J.A. de. Instituto de Pesquisas Energeticas e Nucleares (IPEN), Sao Paulo, SP (Brazil). Aug 1992. [25p.] (In Portuguese). (CONF-8910496–: 14. annual symposium of the ACIESP, Sao Paulo (Brazil), 9-13 Oct 1989). Order Number DE93629071. Source: OSTI; NTIS (US Sales Only); INIS.

A study has been developed in order to establish a chemical process for recovering thorium from wastes produced at the Thorium Purification Plant of the Instituto de Pesquisas Energeticas e Nucleares. The recovery of thorium in this process will be made by means of solvent extraction technique. Solutions of TBP/Varsol were employed as extracting agent during the runs. The influence of thorium concentration in the solution, aqueous phase acidity,

volume ratio of the phases, percentage of TBP/Varsol and the contact time of the phases on the extraction of thorium and lanthanides was determined. (author).

25719 (JAERI-M–93-037) **Progress report on safety research on high-level waste management for the period April 1991 to March 1992.** Muraoka, Susumu (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment); Senoo, Muneaki; Kobayashi, Yoshii (eds.). Japan Atomic Energy Research Inst., Tokyo (Japan). Mar 1993. 78p. Order Number DE93797620. Source: OSTI; NTIS; INIS.

Research on high-level waste management at the Engineered Barrier Materials Laboratory, Environmental Geochemistry Laboratory and Environmental Radiochemistry Laboratory of the Department of Environmental Safety Research, JAERI in the fiscal year of 1991 are described. The topics are as follows: (1) As for waste forms and engineered barrier material, performance assessment studies on glass, ceramic and buffer materials were carried out. (2) In the safety evaluation study for geological disposal, behavior of radionuclide in deep underground water, nuclide migration in-situ and natural groundwater flow system were studied. (3) Changes in layer charge of smectite, alteration of uranium mineral and uranium fixation in uranium ore were examined as a natural analogue study. (author).

25720 (KCP–613-5137) **Process waste assessment approach, training, and technical assistance for DOE contractors.** Pemberton, S.E. Allied-Signal Aerospace Co., Kansas City, MO (United States). Kansas City Div. Apr 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00613. (CONF-930483–1: 9. waste minimization and pollution prevention conference, San Francisco, CA (United States), 13-15 Apr 1993). Order Number DE93012175. Source: OSTI; NTIS; INIS; GPO Dep.

Short communication. US DOE/waste management; MINIMIZATION; REGULATIONS; EVALUATION; HAZARDOUS MATERIALS; KANSAS CITY PLANT; CONTRACTORS; TRAINING

25721 (KEMAKTA-AR–92-08) **Basis for criteria for exemption of decommissioning waste: reprocessing of dust from recycling of steel.** Elert, M.; Wiborgh, M. Kemakta Konsult AB, Stockholm (Sweden). Jun 1992. [38p.] Order Number DE93631579. Source: OSTI; NTIS; INIS.

This study is a part of a larger study with the purpose to provide the authority concerned, the Swedish Radiation Protection Institute (SSI), with technical background material needed for future decisions concerning exemption levels for recycling and disposal of material originating from decommissioned nuclear power reactors. The dismantling of nuclear power reactors will give rise to large amounts of steel scrap with a very low activity concentration. It is of interest to exempt this material from regulatory control in order to make recycling possible. During the melting of steel scrap dust will be formed which is collected in the off-gas cleaning system of the furnace. Radionuclides may be enriched in this dust, and thereby obtain a higher activity concentration than the melted scrap. Presently, there is a strong interest to reprocess these dusts with the objectives to recover valuable metals and to reduce the amounts of waste harmful to the environment. During the reprocessing of dusts collected from the melting process a further redistribution and reconcentration of radionuclides may occur. In this report the treatment of dust from steel melting is described, the potential reconcentration of radionuclides is analyzed, and the potential radiological consequences are estimated. The study has focussed on the reprocessing of dust with the plasma method used at ScanDust in Sweden, and with the Waelz process used in, for example Spain and Germany. Various factors as economical, political and future developments of dust treatment and steel processes will determine the amounts of dusts produced and also to what degree dust will be reprocessed in the future. (au).

25722 (K/TCD–1054) **Electroosmotic decontamination of concrete.** Bostick, W.D. (Oak Ridge K-25 Site, TN (United States)); Bush, S.A.; Marsh, G.C.; Henson, H.M.; Box, W.D.; Morgan, I.L. Oak Ridge K-25 Site, TN (United States). Mar 1993. 73p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OT21400. Order Number DE93010258. Source: OSTI; NTIS; INIS; GPO Dep.

A method is described for the electroosmotic decontamination of concrete surfaces, in which an electrical field is used to induce migration of ionic contaminants from porous concrete into an electrolyte solution that may be disposed of as a low-level liquid radioactive waste (LLRW); alternately, the contaminants from the solution can be sorbed onto anion exchange media in order to prevent contaminant buildup in the solution and to minimize the amount of LLRW generated. We have confirmed the removal of uranium (and infer the removal of ^{99}Tc) from previously contaminated concrete surfaces. In a typical experimental configuration, a stainless steel mesh is placed in an electrolyte solution contained within a diked cell to serve as the negative electrode (cathode) and contaminant collection medium, respectively, and an existing metal penetration (e.g., piping, conduit, or rebar reinforcement within the concrete surface) serves as the positive electrode (anode) to complete the cell. Typically we have achieved 70 to >90% reductions in surface activity by applying <400 V and <1 A for 1–3 h (energy consumption of 0.4–12 kWh/ft^2).

25723 (LA–12589-MS) **Evaluation of ferrocyanide/nitrate explosive hazard.** Cady, H.H. Los Alamos National Lab., NM (United States). Jun 1992. 76p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93015655. Source: OSTI; NTIS; INIS; GPO Dep.

Los Alamos National Laboratory agreed to assist Pacific Northwest Laboratory in the Ferrocyanide Safety Evaluation Program by helping to evaluate the explosive hazard of several mixtures of simulated ferrocyanide waste-tank sludge containing sodium nitrite and sodium nitrate. This report is an evaluation of the small-scale safety tests used to assess the safety of these materials from an explosive point of view. These tests show that these materials are not initiated by mechanical insult, and they require an external heat source before any exothermic chemical reaction can be observed.

25724 (LA-SUB–93-164) **Assessment of greater-than-Class C waste at Los Alamos National Laboratory.** Shuman, R. (Rogers and Associates Engineering Corp., Salt Lake City, UT (United States)); Jennrich, E.A.; Merrell, G.B. Los Alamos National Lab., NM (United States); Rogers and Associates Engineering Corp., Salt Lake City, UT (United States). Feb 1991. 55p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (RAE–8915/3-3). Order Number DE93010746. Source: OSTI; NTIS; INIS; GPO Dep.

Department of Energy (DOE) Order 5820.2A regulates the onsite disposal of low-level radioactive waste (LLW) at all DOE facilities. Among its stipulations, the Order states that "Disposition of wastes designated as greater-than-Class C, as defined in 10 CFR 61.55 must be handled as special cases. Disposal systems for such waste must be justified by a specific performance assessment." Los Alamos National Laboratory (LANL) personnel have undertaken a review and performance assessment of LLW disposal at its Area-G disposal facility, which is described in this report.

25725 (LA-UR–93-1205) **Hazardous waste treatment facility and skid-mounted treatment systems at Los Alamos.** Lussiez, G.W.; Zygmunt, S.J. Los Alamos National Lab., NM (United States). [1993]. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930873–6: 2. international mixed waste symposium, Baltimore, MD (United States), 17-20 Aug 1993). Order Number DE93012660. Source: OSTI; NTIS; INIS; GPO Dep.

To centralize treatment, storage, and staging areas for hazardous wastes, Los Alamos National Laboratory has designed a 12,000-ft^2 hazardous waste treatment facility. The facility will house a treatment room for each of four kinds of wastes: nonradioactive characteristic wastes, nonradioactive listed wastes radioactive characteristic wastes, and radioactive listed wastes. The facility will be used for repacking labpacks, bulking small organic waste volumes, processing scintillation vials, treating reactives such as lithium hydride and pyrophoric uranium, treating contaminated solids such as barium sand, and treating plating wastes. The treated wastes will then be appropriately disposed of. This report describes the integral features of the hazardous waste treatment facility.

25726 (LA-UR–93-1598) **Field studies of engineered barriers for closure of low level radioactive waste landfills at Los Alamos, New Mexico, USA.** Nyhan, J.W.; Langhorst, G.J.; Martin, C.E.; Martinez, J.L.; Schofield, T.G. Los Alamos National Lab., NM (United States). [1993]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930906–8: '93 international conference on nuclear waste management and environmental remediation, Prague (Czech Republic), 5-11 Sep 1993). Order Number DE93012725. Source: OSTI; NTIS; INIS; GPO Dep.

The Los Alamos National Laboratory examined water balance relationships for four different landfill cover designs containing engineered barriers. These field experiments were performed at Los Alamos, New Mexico, USA, in 1.0- by 10.0-m plots with downhill slopes of 5, 10, 15, and 25%. Field measurements of seepage, precipitation, interflow, runoff, and soil water content were collected in each of the 16 plots representing four slopes each with four cover designs: Conventional, EPA, Loam Capillary Barrier and Clay Loam Capillary Barrier. A seepage collection system was installed beneath each cover design to evaluate the influence of slope length on seepage using a series of four metal pans filled with medium gravel that were placed end-to-end in the bottom of each field plot. An automated water flow data logging system was used to collect hourly seepage, interflow and runoff data and consisted of 100 100-liter tanks, each of which was equipped with an ultrasonic liquid-level sensor and a motor-operated ball valve used to drain the tank. Soil water content was routinely monitored every six hours at each of 212 locations throughout the 16 plots with time domain reflectrometry (TDR) techniques using an automated and multiplexed measurement system. Field data is presented to show the effects of slope and slope length on the performance of each landfill cover design for the first 15 months of this field experiment.

25727 (LA-UR–93-1960) **Los Alamos aqueous target/blanket system design for the accelerator transmutation of waste concept.** Cappiello, M.; Ireland, J.; Sapir, J.; Krohn, B. Los Alamos National Lab., NM (United States). [1993]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930913–1: Global '93: future nuclear systems - emerging fuel cycles and waste disposal options, Seattle, WA (United States), 12-17 Sep 1993). Order Number DE93014355. Source: OSTI; NTIS; INIS; GPO Dep.

The Los Alamos Accelerator Transmutation of Nuclear Waste (ATW) concept uses an accelerator driven neutron source (target) surrounded by a moderator and multiplying medium (blanket) for the transmutation of actinide and fission product waste. The reference target/blanket desip is an aqueous system that uses heavy water (D_2O) for the target coolant, blanket moderator, actinide slurry carrier fluid, and fission product solution. The solid tungsten target produces neutrons efficiently and with a minimum of parasitic capture using an innovative flux-trap design. The blanket consists of regions for fission products and actinide transmutation and employs a heat-transfer loop similar to the CANDU reactor. Neutronics and thermal-hydraulic calculations indicate that each of the four ATW target/blanket modules operating at a k_{eff} of 0.95, combined with a 1600-MeV, 62.5-mA proton beam, can transmute the actinide waste, the technetium, and iodine waste from two light water reactors. In addition, by recovering some of the fission heat, we can produce sufficient electricity to power the accelerator.

25728 (LBL–23593) **Preliminary capillary hysteresis simulations for fractured rocks – model development and results of simulations.** Niemi, A.; Bodvarsson, G.S. Lawrence Berkeley Lab., CA (United States). Nov 1991. 85p. Sponsored by USDOE, Washington, DC (United States); Department of the Interior, Washington, DC (United States). DOE Contract AC03-76SF00098. Order Number DE93015280. Source: OSTI; NTIS; GPO Dep.

As part of the code development and modeling work being carried out to characterize the flow in the unsaturated zone at Yucca Mountain, Nevada, capillary hysteresis models simulating the history-dependence of the characteristic curves have been developed. The objective of the work has been both to develop the hysteresis models, as well as to obtain some preliminary estimates of the possible hysteresis effects in the fractured rocks at Yucca Mountain given the limitations of presently available data. Altogether three different models were developed based on work of other investigators reported in the literature. In these three models different principles are used for determining the scanning paths: in model (1) the scanning paths are interpolated from tabulated first-order scanning curves, in model (2) simple interpolation functions are used for scaling the scanning paths from the expressions of the main wetting and main drying curves and in model (3) the scanning paths are determined from expressions derived based on the dependent domain theory of hysteresis.

25729 (LBL–33597) **Modeling of strongly heat-driven flow processes at a potential high-level nuclear waste repository at Yucca Mountain, Nevada.** Pruess, K.; Tsang, Y. Lawrence Berkeley Lab., CA (United States). Jan 1993. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098 ;AC04-76DP00789. (CONF-930408–59: International high-level radioactive waste management conference, Las Vegas, NV (United States), 25-29 Apr 1993). Order Number DE93010450. Source: OSTI; NTIS; INIS; GPO Dep.

Two complementary numerical models for analyzing high-level nuclear waste emplacement at Yucca Mountain have been developed. A vertical cross-sectional (X-Z) model permits a realistic representation of hydrogeologic features, such as alternating tilting layers of welded and non-welded tuffs. fault zones, and surface topography. An alternative radially symmetric (R-Z) model is more limited in its ability to describe the hydrogeology of the site, but is better suited to model heat transfer in the host rock. Our models include a comprehensive description of multiphase fluid and heat flow processes, including strong enhancements of vapor diffusion from pore-level phase change effects. The neighborhood of the repository is found to partially dry out from the waste heat. A condensation halo of large liquid saturation forms around the drying zone, from which liquid flows downward at large rates. System response to infiltration from the surface and to ventilation of mined openings is evaluated. The impact of the various flow processes on the waste isolation capabilities of the site is discussed.

25730 (MHSMP–92-41) **Laboratory solvent reuse – Liquid chromatography.** Quinlin, W.T.; Schaffer, C.L. Mason and Hanger-Silas Mason Co., Inc., Amarillo, TX (United States). Nov 1992. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-91AL65030. Order Number DE93009948. Source: OSTI; NTIS; GPO Dep.

The objective of this work was to develop a method for reduction of waste solvent in the Process Engineering Chemistry Laboratory. The liquid chromatographs are the largest generators of explosive-contaminated waste in the laboratory. We developed a successful process for the reuse of solvents from the liquid chromatographs and demonstrated the utility of the process in the assay of hexanitrostilbene.

25731 (NEI-SE–117) **Treatment and final disposal of nuclear waste. Aespoe hard rock laboratory.** Swedish Nuclear Fuel and Waste Management Co., Stockholm (Sweden). Sep 1992. [89p.] Order Number DE93631589. Source: OSTI; NTIS; INIS.

Background report to RD and D Programme 92.

The scientific investigations within SBK's research programme are a part of the work of designing a deep repository and identifying and investigating a suitable site. A balanced appraisal of the facts, requirements and assessments presented in connection with the preparation of R and D-programme 86 led to the proposal to construct an underground research laboratory. This proposal was presented in the aforementioned research programme and was very positively recived by the reviewing bodies. In the autumn of 1986, SKB initiated the field work for the siting of an underground laboratory, the Aespoe hard rock laboratory, in the Simpevarp area in the municipality of Oskarshamn. At the end of 1988, SKB arrived at a decision in principle to site the facility on southern Aespoe about 2 km north of the Oskarshamn nuclear power station. After regulatory review, SKB ordered the excavation of the access tunnel to the Aespoe hard rock laboratory to commence in the autumn of 1990. In conjunction with the tunneling work, which has now (September 1992) reached a depth of more than 200 m, a large number of investigations have been carried out. This background report to SKB's RD and D-programme 92 is based on the previous and 89 /

2/. The report provides a general background and presents goals, projects results obtained to date and future work. Compared to the previous background reports, more space is devoted here to experiment planning and the future demonstration programme. (au).

25732 (NUREG/CR–5943) **Sensitivity analysis and benchmarking of the BLT low-level waste source term code.** Suen, C.J. (Brookhaven National Lab., Upton, NY (US)); Sullivan, T.M. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Regulatory Applications; Brookhaven National Lab., Upton, NY (United States). Jul 1993. 78p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC02-76CH00016. (BNL-NUREG–52346). Source: OSTI; NTIS; INIS; GPO.

To evaluate the source term for low-level waste disposal, a comprehensive model had been developed and incorporated into a computer code, called BLT (Breach-Leach-Transport) Since the release of the original version, many new features and improvements had also been added to the Leach model of the code. This report consists of two different studies based on the new version of the BLT code: (1) a series of verification/sensitivity tests; and (2) benchmarking of the BLT code using field data. Based on the results of the verification/sensitivity tests, the authors concluded that the new version represents a significant improvement and it is capable of providing more realistic simulations of the leaching process. Benchmarking work was carried out to provide a reasonable level of confidence in the model predictions. In this study, the experimentally measured release curves for nitrate, technetium-99 and tritium from the saltstone lysimeters operated by Savannah River Laboratory were used. The model results are observed to be in general agreement with the experimental data, within the acceptable limits of uncertainty.

25733 (NUREG/CR–5987) **Microbial-influenced cement degradation: Literature review.** Rogers, R.D. (EG and G Idaho, Inc., Idaho Falls, ID (United States)); Hamilton, M.A.; McConnell, J.W. Jr. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Regulatory Applications; EG and G Idaho, Inc., Idaho Falls, ID (United States). Mar 1993. 26p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC07-76ID01570. (EGG–2695). Source: OSTI; NTIS; INIS; GPO.

The Nuclear Regulatory Commission stipulates that disposed low-level radioactive waste (LLW) be stabilized. Because of apparent ease of use and normal structural integrity, cement has been widely used as a binder to solidify LLW. However, the resulting waste forms are sometimes susceptible to failure due to the actions of waste constituents, stress, and environment. This report reviews literature which addresses the effect of microbiologically influenced chemical attack on cement-solidified LLW. Groups of microorganisms are identified, which are capable of metabolically converting organic and inorganic substrates into organic and mineral acids. Such acids aggressively react with concrete and can ultimately lead to structural failure. Mechanisms inherent in microbial-influenced degradation of cement-based material are the focus of this report. This report provides sufficient evidence of the potential for microbial-influenced deterioration of cement-solidified LLW to justify the enumeration of the conditions necessary to support the microbiological growth and population expansion, as well as the development of appropriate tests necessary to determine the resistance of cement-solidified LLW to microbiological-induced degradation that could impact the stability of the waste form.

25734 (ORNL/ER–12) **Investigation of the organic matter in inactive nuclear tank liquids: Environmental Restoration Program.** Schenley, R.L.; Griest, W.H. Oak Ridge National Lab., TN (United States). Aug 1990. 29p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93014339. Source: OSTI; NTIS; INIS; GPO Dep.

Environmental Protection Agency (EPA) methodology for regulatory organics fails to account for the organic matter that is suggested by total organic carbon (TOC) analysis in the Oak Ridge National Laboratory (ORNL) inactive nuclear waste-tank liquids and sludges. Identification and measurement of the total organics are needed to select appropriate waste treatment technologies. An initial investigation was made of the nature of the organics in several waste-tank liquids. This report details the analysis of ORNL wastes.

25735 (ORNL/ER/Sub–87-99053/64) **Waste management plan for the remedial investigation/feasibility study of Waste Area Grouping 5 at Oak Ridge National Laboratory, Oak Ridge, Tennessee: Environmental Restoratin Program.** Oak Ridge National Lab., TN (United States); Bechtel National, Inc., Oak Ridge, TN (United States). Dec 1992. 32p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93009335. Source: OSTI; NTIS; INIS; GPO Dep.

This plan defines the criteria and methods to be used for managing waste generated during activities associated with Waste Area Grouping (WAG) 5 at Oak Ridge National Laboratory (ORNL). WAG 5 is located in Melton Valley, south of the main ORNL plant area. It contains 17 solid waste management units (SWMUs) to be evaluated during the remedial investigation. The SWMUs include three burial areas, two hydrofracture facilities, two settling ponds, eight tanks, and two low-level liquid waste leak sites. These locations are all considered to be within the WAG 5 area of contamination (AOC). The plan contains provisions for safely and effectively managing soils, rock cuttings, development and sampling water, decontamination fluids, and disposable personal protective equipment (PPE) consistent with the Environmental Protection Agency (EPA) guidance of May 1991 (EPA 1991). Consistent with EPA guidance, this plan is designed to protect the environment and the health and safety of workers and the public.

25736 (ORNL/FTR–4496) **[Transportation/geologic repository interface requirements for high level radioactive waste and spent nuclear fuel]: Foreign trip report, November 7–24, 1992.** Pope, R.B. Oak Ridge National Lab., TN (United States). 9 Dec 1992. 92p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93009563. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The traveler attended and participated in two meetings at the International Atomic Energy Agency (IAEA) in Vienna, Austria. The first meeting was the Advisory Group Meeting on Transportation/Geologic Repository Interface Requirements for High Level Radioactive Waste and Spent Nuclear Fuel. The second meeting was the Consultants Services Meeting on Low Specific Activity and Surface Contaminated Object Material. The consultants initiated their work using a set of working papers provided by the Agency, with the goal of providing the Agency with recommendations on a Low Specific Activity Material Q-System Analogue for defining activity limits, materials specifications, and packaging requirements for such materials. The consultants' efforts resulted in a modified but unreviewed draft position paper and associated documentation of the consultants' deliberations; these documents were to be typed by the IAEA, forwarded to the consultants for review, and when modified by the IAEA based upon the consultants' comments, circulated for review by member states to serve as a basis for further consideration by the IAEA in future meetings.

25737 (ORNL/TM–11838) **In situ grouting of low-level burial trenches with a cement-based grout at Oak Ridge National Laboratory.** Francis, C.W.; Spence, R.D.; Tamura, T.; Spalding, B.P. Oak Ridge National Lab., TN (United States). Jan 1993. 92p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93012513. Source: OSTI; NTIS; INIS; GPO Dep.

Environmental Sciences Division Publication No. 3872.

A technology being evaluated for use in the closure of one of the low-level radwaste burial grounds at ORNL is trench stabilization using a cement-based grout. To demonstrate the applicability and effectiveness of this technology, two interconnecting trenches in SWSA 6 were selected as candidates for in situ grouting with a particulate grout. The primary objective was to demonstrate the increased trench stability (characterized by trench penetration tests) and the decreased potential for leachate migration (characterized by hydraulic conductivity tests) following in situ injection of a particulate grout into the waste trenches. Stability against trench subsidence is a critical issue. For example, construction of impermeable covers to seal the trenches will be ineffectual unless subsequent trench subsidence is permanently suspended. A grout composed of 39% Type 1 Portland cement, 55.5% Class F fly ash,

and 5.5% bentonite mixed at 12.5 lb/gal of water was selected. Before the trenches were grouted, the primary characteristics relating to physical stability, hydraulic conductivity, and void volume of the trenches were determined. Their physical stability was evaluated using soil-penetration tests.

25738 (ORNL/TM–12058) **Simulation of barrier heterogeneity and preferential flow effects on the performance of shallow land burial facilities.** Luxmoore, R.J.; Tharp, M.L. Oak Ridge National Lab., TN (United States). Mar 1993. 38p. Sponsored by Environmental Protection Agency, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93009337. Source: OSTI; NTIS; GPO Dep.

Environmental Sciences Division Publication No. 3844.

Compacted soil barriers constructed at landfill sites have some degree of heterogeneity in hydraulic properties that may lead to a decline in barrier integrity and performance. A computer modeling study of the water dynamics of compacted soil barriers for a mesic site in eastern Tennessee was undertaken to identify possible situations that could lead to barrier failure. A water dynamics model for soil-plant systems (UTM) was applied to three landful construction scenarios, and varying degrees of heterogeneity of hydraulic properties for the cap and liner were introduced with a scaling procedure. Simulations were conducted for three annual contrasting rainfall conditions, and sensitivity analysis and Monte Carlo methods were used in the investigation.

25739 (ORNL/TM–12315) **Development and testing of ion exchangers for treatment of liquid wastes at Oak Ridge National Laboratory.** Collins, J.L. (Oak Ridge National Lab., TN (United States)); Davidson, D.J.; Chase, C.W.; Egan, B.Z.; Ensor, D.D.; Bright, R.M.; Glasgow, D.C. Oak Ridge National Lab., TN (United States). Mar 1993. 53p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93013460. Source: OSTI; NTIS; INIS; GPO Dep.

This report addresses three areas of waste treatment: (1) treatment of newly generated low-level liquid waste and Melton Valley Storage Tank (MVST) supernate using inorganic ion exchangers; (2) treatment of processing streams at the Radiochemical Engineering Development Center (REDC); and (3) removal of radionuclides from organic solutions. Distribution of various radionuclides between simulated waste solutions and several sorbents was determined in batch tests. Inorganic ion exchangers were prepared in the form of microspheres by an internal gelation process. Microspheres of hydrous titania, hydrous zirconia, hydrous titania containing embedded sodium cobalt hexacyanoferrate, and the corresponding phosphate forms of these materials were prepared. Several zeolites (PDZ-140, PDZ-300, EE-96, CBV-10A) and inorganic ion exchangers (hydrous titania, hydrous zirconia, polyantimanic acid, sodium cobalt hexacyanoferrate) were tested for the removal of cesium and strontium from the acidic simulated Cleanex raffinate generated at REDC. A resorcinol-based ion-exchange resin and three types of sodium titanate were tested for removal of cesium and strontium from the REDC caustic dissolver solution. Hydrous titania, hydrous zirconia, and their corresponding phosphates were tested for the removal of Eu^{3+} from various solutions of di-2-ethylbexyl phosphoric acid (HDEHP) in toluene or dodecane.

25740 (PNL–8266) **Methods of chemical analysis for organic waste constituents in radioactive materials: A literature review.** Clauss, S.A.; Bean, R.M. Pacific Northwest Lab., Richland, WA (United States). Feb 1993. 60p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93008627. Source: OSTI; NTIS; INIS; GPO Dep.

Most of the waste generated during the production of defense materials at Hanford is presently stored in 177 underground tanks. Because of the many waste treatment processes used at Hanford, the operations conducted to move and consolidate the waste, and the long-term storage conditions at elevated temperatures and radiolytic conditions, little is known about most of the organic constituents in the tanks. Organics are a factor in the production of hydrogen from storage tank 101-SY and represent an unresolved safety question in the case of tanks containing high organic carbon content. In preparation for activities that will lead to the characterization of organic components in Hanford waste storage tanks, a thorough search of the literature has been conducted to identify those procedures that have been found useful for identifying and quantifying organic components in radioactive matrices. The information is to be used in the planning of method development activities needed to characterize the organics in tank wastes and will prevent duplication of effort in the development of needed methods.

25741 (PNL–8438) **Exploratory study of complexant concentrate waste processing.** Lumetta, G.J.; Bray, L.A.; Kurath, D.E.; Morrey, J.R.; Swanson, J.L.; Wester, D.W. Pacific Northwest Lab., Richland, WA (United States). Feb 1993. 60p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93008949. Source: OSTI; NTIS; GPO Dep.

The purpose of this exploratory study, conducted by Pacific Northwest Laboratory for Westinghouse Hanford Company, was to determine the effect of applying advanced chemical separations technologies to the processing and disposal of high-level wastes (HLW) stored in underground tanks. The major goals of this study were to determine (1) if the wastes can be partitioned into a small volume of HLW plus a large volume of low-level waste (LLW), and (2) if the activity in the LLW can be lowered enough to meet NRC Class LLW criteria. This report presents the results obtained in a brief scouting study of various processes for separating radionuclides from Hanford complexant concentrate (CC) waste.

25742 (PNL–8518) **Similarity analysis applied to the design of scaled tests of hydraulic mitigation methods for Tank 241-SY-101.** Liljegren, L.M. Pacific Northwest Lab., Richland, WA (United States). Feb 1993. 70p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93007930. Source: OSTI; NTIS; INIS; GPO Dep.

The episodic gas releases from Tank 241-SY-101 (SY-101) pose a potential safety hazard. It is thought that gas releases occur because gases are generated and trapped in layers of settled solids located at the bottom of the tank. This document focuses on issues associated with testing of hydraulic mitigation technologies proposed for SY-101. The basic assumption underlying the concept of hydraulic mitigation is that mobilization or maintained suspension of the solids settled in the bottom of the tank wig prevent gas accumulation. Engineering of hydraulic technologies will require testing to determine the operating parameters required to mobilize the solids and to maintain these solids in suspension. Because full scale testing is extremely expensive (even when possible), scaled tests are needed to assess the merit of the proposed technologies and to provide data for numerical or analytical modeling. This research is conducted to support testing and evaluation of proposed hydraulic mitigation concepts only. The work here is oriented towards determining the jet velocities, nozzle sizes, and other operating parameters required to mobilize the settled solids in SY-101 and maintain them in suspension.

25743 (PNL–8601) **Pretreatment of Plutonium Finishing Plant (PFP) sludge: Report for the period October 1990–March 1992.** Lumetta, G.J.; Swanson, J.L. Pacific Northwest Lab., Richland, WA (United States). Apr 1993. 59p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93014684. Source: OSTI; NTIS; INIS; GPO Dep.

The current mission of the US Department of Energy's Hanford Site is one of environmental restoration. A major task within this mission is the disposal of large volumes of high-level wastes (HLW) that are stored in underground tanks on the site. Under the current planning assumptions, all high-level tank waste will be vitrified as borosilicate glass and then disposed of in a geologic repository. The costs associated with this disposal scheme are very high. Thus, methods to reduce the volume of glass required to vitrify these wastes are currently being investigated. Plutonium Finishing Plant (PFP) sludge is a unique transuranic waste that is stored in tank 241- SY-102 on the Hanford site. As the name implies, the bulk of this material consists of waste from operations at the Plutonium Finishing Plant; but, other wastes have also been added (e.g., wastes from decontamination activities). Because the quantities of plutonium and americium in the PFP sludge are greater than 100 nCi/g, this sludge must be handled as a HLW. Approximately 6000 glass canisters would result from vitrifying this waste directly. Sludge washing would reduce the required number

of canisters to ~2500, with the volume of glass being driven by the low allowable concentration limit for Cr in the vitrification plant feed. The cost of production and subsequent geologic disposal of each canister of glass is expected to be $0.5 M to $1 M. Thus, an economic incentive exists to develop methods of pretreating the sludge to reduce the number of glass canisters needed to contain the final vitrified product.

25744 (PNL-SA–21455) **Effect of potential Hanford ferrocyanide waste constituents on the reaction between ferrocyanide and nitrates/nitrites.** Scheele, R.D.; Burger, L.L.; Sell, R.L. Pacific Northwest Lab., Richland, WA (United States). Feb 1993. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-930205–57: Waste management '93, Tucson, AZ (United States), 28 Feb - 4 mar 1993). Order Number DE93010189. Source: OSTI; NTIS; INIS; GPO Dep.

During the 1950s, ferrocyanide- and nitrate-bearing wastes were produced at Hanford. A concern about continued safe storage and future treatment of these wastes has arisen because ferrocyanide and nitrate mixtures can explode when heated. Because of this concern, the Pacific Northwest Laboratory has performed experimental studies to determine the conditions needed to continue storing the wastes safely. In this paper, we present the results of our studies on the effects of other potential ferrocyanide waste constituents on the explosivity of mixtures of sodium nickel ferrocyanide and sodium nitrate and nitrite. In particular, this paper presents the results of investigations on the diluent effects of equimolar sodium nitrate and nitrite, sodium nickel ferrocyanide, and sodium aluminate, and the catalyst or initiator effects of nickel sulfide.

25745 (PNL-SA–21482) **Evaluating the technical aspects of mixed waste treatment technologies.** Bagaasen, L.M.; Scott, P.A. Pacific Northwest Lab., Richland, WA (United States). Oct 1992. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-9210297–1: Mixed waste regulation conference, Albuquerque, NM (United States), 26-27 Oct 1992). Order Number DE93007873. Source: OSTI; NTIS; INIS; GPO Dep.

This report discusses treatment of mixed wastes which is thought to be more complicated than treatment of either hazardous or radioactive wastes. In fact, the treatment itself is no more complicated: however, the regulations that define acceptability of the final waste disposal system are significantly more entangled, and sometimes in apparent conflict. This session explores the factors that influence the choice of waste treatment technologies, and expands on some of the limitations to their application. The objective of the presentation is to describe the technical factors that influence potential treatment processes and the ramifications associated with particular selections (for example, the generation of secondary waste streams). These collectively provide a framework for making informed treatment process selections.

25746 (PNL-SA–21716) **TWEAT: Ternary Waste Envelope Assessment Tool.** Robertus, R.J. (Pacific Northwest Lab., Richland, WA (United States)); Hrma, P.R.; Lambert, R. Pacific Northwest Lab., Richland, WA (United States). Feb 1993. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-930205–40: Waste management '93, Tucson, AZ (United States), 28 Feb - 4 mar 1993). Order Number DE93009325. Source: OSTI; NTIS; INIS; GPO Dep.

TWEAT is a graphical visualization software tool used to support activities at the Hanford Waste Vitrification Project. It requires the user to input the chemical composition of streams that will be mixed to produce glass, along with the property limits that the glass must meet. Using built-in property models, TWEAT then displays on a ternary diagram an "acceptable composition region" and a "qualified composition region" where glass can be produced. The "qualified composition region" is the most restrictive area. It meets all specified property limits and does not extrapolate any property models.

25747 (PNL-SA–21885) **Laboratory-scale vitrification and leaching of Hanford high-level waste for the purpose of simulant and glass property models validation.** Morrey, E.V.; Elliott, M.L.; Tingey, J.M. Pacific Northwest Lab., Richland, WA (United States). Feb 1993. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-930205–49: Waste management '93, Tucson, AZ (United States), 28 Feb - 4 mar 1993). Order Number DE93010168. Source: OSTI; NTIS; INIS; GPO Dep.

The Hanford Waste Vitrification Plant (HWVP) is being built to process the high-level and TRU waste into canistered glass logs for disposal in a national repository. Testing programs have been established within the Project to verify process technology using simulated waste. A parallel testing program with actual radioactive waste is being performed to confirm the validity of using simulates and glass property models for waste form qualification and process testing. The first feed type to be processed by and the first to be tested on a laboratory-scale is pretreated neutralized current acid waste (NCAW). The NCAW is a neutralized high-level waste stream generated from the reprocessing of irradiated nuclear fuel in the Plutonium and Uranium Extraction (PUREX) Plant at Hanford. As part of the fuel reprocessing, the high-level waste generated in PUREX was denitrated with sugar to form current acid waste (CAW). Sodium hydroxide and sodium nitrite were added to the CAW to minimize corrosion in the tanks, thus yielding neutralized CAW. The NCAW contains small amounts of plutonium, fission products from the irradiated fuel, stainless steel corrosion products, and iron and sulfate from the ferrous sulfamate reductant used in the PUREX process. This paper will discuss the results and status of the laboratory-scale radioactive testing.

25748 (PNL-SA–22070) **UV and IR laser ablation for inductively coupled plasma mass spectrometry.** Smith, M.R.; Koppenaal, D.W.; Farmer, O.T. Pacific Northwest Lab., Richland, WA (United States). Jun 1993. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-9304144–9: 2. international conference on laser ablation: mechanisms and applications, Knoxville, TN (United States), 19-22 Apr 1993). Order Number DE93017124. Source: OSTI; NTIS; INIS; GPO Dep.

Laser ablation particle plume compositions are characterized using inductively coupled plasma mass spectrometry (ICP/MS). This study evaluates the mass response characteristics peculiar to ICP/MS detection as a function of laser fluence and frequency. Evaluation of the ICP/MS mass response allows deductions to be made concerning how representative the laser ablation produced particle plume composition is relative to the targeted sample. Using a black glass standard, elemental fractionation was observed, primarily for alkalis and other volatile elements. The extent of elemental fractionation between the target sample and the sampled plume varied significantly as a function of laser fluences and IR and UV laser frequency.

25749 (PNL-SA–22089) **The US Army HazMin probe model.** Kuusinen, T. (Pacific Northwest Lab., Richland, WA (United States)); Dirks, J.; Brothers, A.; Fowler, K.; Skumanich, M.; Scola, R.; Perich, A.; Napolitano, M. Pacific Northwest Lab., Richland, WA (United States). Mar 1993. 7p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-930323–2: 19. environmental vision 2000: DOE/EPA/USCG - can current technology and resources get us there, Albuquerque, NM (United States), 23-27 Mar 1993). Order Number DE93012868. Source: OSTI; NTIS; INIS; GPO Dep.

In 1987, the US Department of Defense (DOD) established a goal of reducing the quantity of hazardous waste generated by DOD facilities by 50%. To help achieve this goal, the US Army Production Base Modernization Activity (PBMA) has contracted with the Pacific Northwest Laboratory (PNL) to develop decision support software to be used in the Army-wide hazardous waste minimization (HazMin) program. The resulting waste minimization prioritization software has been named the Project Opportunity and Benefit Evaluation (PROBE) model. PROBE can be used to evaluate both waste stream and project priorities. PROBE operates on any IBM-compatible personal computer hardware with at least 640K of memory and 5 megabytes of available hard disk space. PROBE was developed under the direction of PBMA, which retains unlimited rights to the Federal version of PROBE. PBMA encourages other DOD services and other Federal agencies to use PROBE to assist in their own waste minimization programs. PNL is also considering developing a copyrighted version of PROBE for

the commercial market. PROBE was written using FoxPro 2.0 application development software, and runs as an executable file from either MS-DOS or Windows. The software can be loaded onto a single high-capacity floppy disk in a compressed format and can be transferred onto hard disk, ready to operate, via a simple start-up routine.

25750 (PNL-SA–22322) **Effect of composition and temperature on viscosity and electrical conductivity of borosilicate glasses for Hanford nuclear waste immobilization.** Hrma, P.; Piepel, G.F.; Smith, D.E.; Redgate, P.E.; Schweiger, M.J. Pacific Northwest Lab., Richland, WA (United States). Apr 1993. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-930438–16: 95. annual meeting of the American Ceramic Society, Cincinnati, OH (United States), 18-22 Apr 1993). Order Number DE93013505. Source: OSTI; NTIS; INIS; GPO Dep.

Viscosity and electrical conductivity of 79 simulated borosilicate glasses in the expected range of compositions to be produced in the Hanford Waste Vitrification Plant were measured within the temperature span from 950 to 1250°C. The nine major oxide components were SiO_2, B_2O_3, Li_2O, Na_2O, CaO, MgO, Fe_2O_3, Al_2O_3, and ZrO_2. The test compositions were generated statistically. The data were fitted by Fulcher and Arrhenius equations with temperature coefficients being multilinear functions of the mass fractions of the oxide components. Mixture models were also developed for the natural logarithm of viscosity and that of electrical conductivity at 1150°C. Least squares regression was used to obtain component coefficients for all the models.

25751 (PNL-SA–22687) **FY 1993 Ferrocyanide Tank Safety Project: Effects of Aging on Ferrocyanide Wastes test plan for the remainder of FY 1993.** Lilga, M.A.; Schiefelbein, G.F. Pacific Northwest Lab., Richland, WA (United States). Jun 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93017217. Source: OSTI; NTIS; INIS; GPO Dep.

Researchers in the Hanford Ferrocyanide Task Team are studying safety issues associated with ferrocyanide precipitates in single shell waste storage tanks (SST). Ferrocyanide is a stable complex of ferrous, ion and cyanide ion that is considered nontoxic because it does not dissociate readily in aqueous solutions. However, in the laboratory at temperatures in excess of 180°C and in the presence of oxidizers such as nitrates and nitrites, dry ferrocyanide and ferrocyanide waste stimulants can be made to react exothermically. The Ferrocyanide Safety Project at the Pacific Northwest Laboratory (PNL) is part of the Waste Tank Safety Program at Westinghouse Hanford Company (WHC). The purpose of the WHC program is to (1) maintain the ferrocyanide tanks with minimal risk of an accident, (2) select one or more strategies to assure safe storage, and (3) close out the unreviewed safety question (USQ). Tank ferrocyanide wastes were exposed to highly alkaline wastes from subsequent processing operations. Chemical reactions with caustic may have changed the ferrocyanide materials during 40 years of storage in the SSTs. Research in the "Effects of Aging on Ferrocyanide Wastes" task is targeted at studying aging of ferrocyanide tank simulants and other ferrocyanide materials to obtain a better understanding of how tank materials may have changed over the years. The research objective in this project is to determine the solubility and hydrolysis characteristics of simulated ferrocyanide tank wastes in alkaline media. The behavior of ferrocyanide simulant wastes is being determined by performing chemical reactions under conditions that might mimic the potential ranges in SST environments. Experiments are conducted at high pH, at high ionic strength, and in the presence of gamma radiation. Verification of simulant study findings by comparison with results with actual waste will also be required.

25752 (SAND–87-1305) **JAC3D – A three-dimensional finite element computer program for the nonlinear quasi-static response of solids with the conjugate gradient method: Yucca Mountain Site Characterization Project.** Biffle, J.H. Sandia National Labs., Albuquerque, NM (United States). Feb 1993. 132p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93015729. Source: OSTI; NTIS; INIS; GPO Dep.

JAC3D is a three-dimensional finite element program designed to solve quasi-static nonlinear mechanics problems. A set of continuum equations describes the nonlinear mechanics involving large rotation and strain. A nonlinear conjugate gradient method is used to solve the equation. The method is implemented in a three-dimensional setting with various methods for accelerating convergence. Sliding interface logic is also implemented. An eight-node Lagrangian uniform strain element is used with hourglass stiffness to control the zero-energy modes. This report documents the elastic and isothermal elastic-plastic material model. Other material models, documented elsewhere, are also available. The program is vectorized for efficient performance on Cray computers. Sample problems described are the bending of a thin beam, the rotation of a unit cube, and the pressurization and thermal loading of a hollow sphere.

25753 (SAND–92-1172) **Room Q data report: Test borehole data from April 1989 through November 1991.** Jensen, A.L. (Sandia National Labs., Albuquerque, NM (United States)); Howard, C.L.; Jones, R.L.; Peterson, T.P. Sandia National Labs., Albuquerque, NM (United States). Mar 1993. 225p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93014407. Source: OSTI; NTIS; INIS; GPO Dep.

Pore-pressure and fluid-flow tests were performed in 15 boreholes drilled into the bedded evaporites of the Salado Formation from within the Waste Isolation Pilot Plant (WIPP). The tests measured fluid flow and pore pressure within the Salado. The boreholes were drilled into the previously undisturbed host rock around a proposed cylindrical test room, Room Q, located on the west side of the facility about 655 m below ground surface. The boreholes were about 23 m deep and ranged over 27.5 m of stratigraphy. They were completed and instrumented before excavation of Room Q. Tests were conducted in isolated zones at the end of each borehole. Three groups of 5 isolated zones extend above, below, and to the north of Room Q at increasing distances from the room axis. Measurements recorded before, during, and after the mining of the circular test room provided data about borehole closure, pressure, temperature, and brine seepage into the isolated zones. The effects of the circular excavation were recorded. This data report presents the data collected from the borehole test zones between April 25, 1989 and November 25, 1991. The report also describes test development, test equipment, and borehole drilling operations.

25754 (SAND–92-1173) **Large-scale brine inflow data report for room Q prior to November 25, 1991.** Jensen, A.L. (Sandia National Labs., Albuquerque, NM (United States)); Jones, R.L.; Lorusso, E.N.; Howard, C.L. Sandia National Labs., Albuquerque, NM (United States). Mar 1993. 172p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93013960. Source: OSTI; NTIS; INIS; GPO Dep.

A large-scale brine inflow test was conducted 655 m below ground surface in a cylindrical test room at the Waste Isolation Pilot Plant (WIPP). This test was the first large-scale WIPP test that allowed periodic access to a sealed, monitored excavation. The test was designed to characterize the environment within the sealed test room (Room Q) and to examine the surrounding host rock to quantify such characteristics as near-surface resistivity and permeability in the formation surrounding the room. Testing began with room boring in July 1989. Data in this report were collected from the time of test start-up through November 25, 1991. Relative humidity, barometric pressure, and temperature were measured in the sealed environment of the test room. Formation closure rates and electrical resistance of the formation close to the room surface were measured to determine the response of the host rock around Room Q. Brine was collected periodically to quantify the amount of inflow from large-scale openings. Results of the measurements are presented in a series of graphs. This report also describes the features of the test.

25755 (SAND–92-1777) **Commercial and research status report for inorganic membranes: Suggested uses in environmental and waste management processes.** Pohl, P.I. Sandia National Labs., Albuquerque, NM (United States). Apr 1993. 33p. Sponsored by USDOE, Washington, DC (United States). DOE

Contract AC04-76DP00789. Order Number DE93013897. Source: OSTI; NTIS; INIS; GPO Dep.

This document reports on a search of the literature regarding inorganic membrane technology for use in hazardous and radioactive waste treatment. The report lists and discusses DOE waste management separation needs where membranes could be used and describes inorganic membranes and the characteristics that may make them applicable for these separations. It may serve as a tool for making waste treatment design decisions and for weighing technical proposals in the area of separations.

25756 (SAND–92-2124C) **Gas barrier design for the WIPP.** Hansen, F.D. (Sandia National Labs., Albuquerque, NM (United States)); Leroch, M.J.; Van Sambeek, L.; Lin, M.S. Sandia National Labs., Albuquerque, NM (United States). [1993]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-930644–10: 34. US symposium on rock mechanics, Madison, WI (United States), 27-30 Jun 1993). Order Number DE93015026. Source: OSTI; NTIS; INIS; GPO Dep.

The Waste Isolation Pilot Plant (WIPP) near Carlsbad, New Mexico, is planned as the first mined repository for transuranic (TRU) wastes generated by defense programs of the United States Department of Energy (DOE). In coming years, tests with radioactive wastes are planned to be conducted at the WIPP. Potential tests include evaluation of gases generated by wastes emplaced in mined alcoves. Barriers must be installed in the entries to the test alcoves to limit gas release during testing. This paper discusses several rock mechanics issues involved in the design of an Alcove Gas Barrier (AGB) for use in these potential tests. The unique requirements placed on a gas barrier, when coupled with the geologic setting and strict regulations, make the AGB design challenging from several perspectives of rock mechanics. The AGB structure will be placed in the WIPP underground, which comprises a layered evaporite sequence of rock. A schematic of the design as it might appear in the WIPP underground is shown in Figure 1. The underlying requirement is that the AGB reduce gas leakage from a test alcove to an acceptable limit. The most likely route for gas leak-age is through a disturbed rock zone (DRZ), which develops in response to the excavation. Among other effects, the loading on the structure is a function of the geometrical arrangement and time, including considerations of installation and service life. Resolution of design issues also requires a defensible measure of conservatism. These considerations give rise to several issues in rock mechanics which are the emphases of this paper.

25757 (SAND–93-7022C) **Direct drilling related releases from the WIPP repository.** Berglund, J.W. (New Mexico Univ., Albuquerque, NM (United States). Engineering Research Inst.). Sandia National Labs., Albuquerque, NM (United States); New Mexico Univ., Albuquerque, NM (United States). Engineering Research Inst. [1993]. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-930906–7: '93 international conference on nuclear waste management and environmental remediation, Prague (Czech Republic), 5-11 Sep 1993). Order Number DE93011688. Source: OSTI; NTIS; INIS; GPO Dep.

Two processes are identified that can influence the quantity of wastes brought to the ground surface when a waste disposal room of the Waste Isolation Pilot Plant is inadvertently penetrated by an exploratory borehole. The first mechanism is that due to the erosion of the borehole wall adjacent to the waste caused by the flowing drilling fluid. The second concerns the borehole spall caused by the flow of waste-generated gas to the borehole. Available literature concerning both processes and a quantitative model for erosion are presented. Calculations are shown that confirm the importance of gas-induced spall but no definitive model is developed. It is concluded that constitutive data for decomposed waste must be developed and additional experiments performed to assess the full significance of this latter mechanism.

25758 (SKB-TR–92-33) **Finnsjoen study site. Scope of activities and main results.** Ahlbom, K. (Conterra AB, Uppsala (Sweden)); Andersson, J.E.; Andersson, Peter; Ittner, T.; Tiren, S.; Ljunggren, C. Swedish Nuclear Fuel and Waste Management Co., Stockholm (Sweden). Dec 1992. [155p.] Order Number DE93631590. Source: OSTI; NTIS; INIS.

The Finnsjoen study site was selected in 1977 to provide input to the KBS-1 and KBS-2 performance assessments. The site was later used as a test site for testing new instruments and new site characterization methods, as well as a research site for studying mainly groundwater flow and groundwater transport. All together, the Finnsjoen studies have involved 11 cored boreholes, down to max 700 m depth, and extensive borehole geophysical, geochemical and geohydraulic measurements, as well as rock stress measurements and tracer tests. This report presents the scope of the Finnsjoen studies together with main results. Conceptual uncertainties in assumptions and models are discussed with emphasis on the models used for the performance assessment SKB91. Of special interest for the Finnsjoen study site is the strong influence caused by a subhorizontal fracture zone on groundwater flow, transport and chemistry.

25759 (SKB-TR–92-35) **Calibration and validation of a stochastic continuum model using the Finnsjoen dipole tracer test. A contribution to INTRAVAL phase 2.** Kung Chen Shan (Royal Inst. of Technology, Stockholm (Sweden)); Cvetkovic, V.; Winberg, A. Swedish Nuclear Fuel and Waste Management Co., Stockholm (Sweden). Dec 1992. [70p.] Order Number DE93631591. Source: OSTI; NTIS; INIS.

A realistic semi-synthetic transmissivity field and dipole tracer test conditions similar the actual field test conditions at Finnsjoen were used to demonstrate a calibration and validation procedure applied to a stochastic continuum model. A validation strategy was set up to address whether a model calibrated and possibly validated on a local model scale, also is validated when extrapolated to a far-field scale. A generated 2D realization of the material property distribution on a far-field scale, honouring the measured single hole data and also recapturing the characteristics of the field dipole tracer test, was selected as an exhaustive reference field. The results of the simulated dipole tracer test on a local scale and of a far-field natural gradient tracer test were considered as reference field results. A large number (N=100) of conditioned parametric realizations of the studied domain were generated and the dipole tracer experiment was simulated for each realization. The porosity of the 2D aquifer model was used to calibrate the stochastic simulations on a local scale. An alternative calibration using a defined index of deviation was also applied. Subsequently, also the natural gradient tracer test was simulated on a far-field scale for the ensemble of realizations. It was found that the realizations which based on the defined index of deviation compared best with the local scale reference results did not recapture the characteristics of the reference far-field results. It was thus concluded that calibration/validation of a model on a local scale is insufficient for validating the model also an another large transport scale. In order to reduce the uncertainty in the far-field simulations more data on the corresponding transport are required. (20 refs.) (au).

25760 (UCRL-ID–111736) **An assessment of potential risk resulting from a maximum credible accident scenario at the proposed explosive waste storage facility (EWSF).** Otsuki, K.; Harrach, R.; Berger, R. Lawrence Livermore National Lab., CA (United States). Oct 1992. 21p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93009445. Source: OSTI; NTIS; INIS; GPO Dep.

Lawrence Livermore National Laboratory (LLNL) proposes to build, permit, and operate a storage facility for explosive wastes at LLNL's Explosive Test Site, Site 300. The facility would consist of four existing magazines, four new magazettes (small concrete vaults), and a new prefabricated metal building. Ash from on-site treatment of explosive waste would also be stored in the prefabricated metal building prior to sampling analysis, and shipment. The magazettes would be installed at each magazine-and would provide segregated storage for explosive waste types including detonators, actuators, and other initiating devices. The proposed facility would be used to store explosive wastes generated by the Hydrotest and Explosive Development Programs at LLNL prior to treatment on-site or shipment to permitted, commercial, off-site treatment facilities. Explosive wastes to be stored in the proposed facility represent a full spectrum of Department of Energy (DOE)

and LLNL explosive wastes. This document identifies and evaluates the risk to human health and the environment associated with the operation of the proposed EWSF.

25761 (UCRL-JC–108635) **Analysis of chromium volatility in the DWTF incinerator and in the molten salt processor.** Ebbinghaus, B.B. Lawrence Livermore National Lab., CA (United States). 2 Apr 1992. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93009251. Source: OSTI; NTIS; INIS; GPO Dep.

Thermodynamic methods have been applied to calculate the volatility of chromium both in atmospheres and in milligrams per cubic meter (stp) of offgas for the decontamination and waste treatment facility (DWTF) incinerator and the Rockwell molten salt processor. The known chromium species which have relatively high stabilities under oxidizing conditions and which contain elements found in either the DWTF incinerator or the molten salt processor are $CrO_2(OH)_2(g)$, $CrO_2OH(g)$, $CrO_3(g)$, $CrO_2Cl_2(g)$, and $CrOF(g)$ and $CrO_2F_2(g)$. This study demonstrates that these species as well as others such as $CrO(OH)_2(g)$, $CrOOH(g)$, $CrO(OH)_3(g)$, $CrO_2Cl(g)$, $CrOC1_2(g)$, $CrOCl(g)$, $CrOC1_3(g)$, $CrOC1_4(g)$, and $CrO_2F(g)$ can all be important species which contribute to the overall volatility of chromium in waste oxidation processes.

25762 (UCRL-JC–112711) **Experimental studies of actinide volatilities with application to mixed waste oxidation processors.** Krikorian, O.H.; Ebbinghaus, B.B.; Condit, R.H.; Adamson, M.G.; Fontes, A.S. Jr.; Fleming, D.L. Lawrence Livermore National Lab., CA (United States). 30 Apr 1993. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-930572–6: 12. annual international symposium on thermal treatment technologies - incineration conference, Knoxville, TN (United States), 3-7 May 1993). Order Number DE93014430. Source: OSTI; NTIS; GPO Dep.

The transpiration technique is used to measure volatilities of U from $U_3O_8(s)$, Pu from $PuO_2(s)$ and Pu and Am from PuO_2/ $2\%AmO_2(s)$ in the presence of steam and oxygen at temperatures ranging from 900 to 1300°C.

25763 (UCRL-JC–113268) **Partitioning and transmutation: Near-term solution or long-term option?.** Ramspott, L.D. (Lawrence Livermore National Lab., CA (US)); Isaacs, T. Lawrence Livermore National Lab., CA (United States). 25 Feb 1993. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-930205–78: Waste management '93, Tucson, AZ (United States), 28 Feb - 4 mar 1993). Order Number DE93016540. Source: OSTI; NTIS; INIS; GPO Dep.

Starting in 1989, the concept that partitioning and transmuting actinides from spent nuclear fuel could be a "solution" to the apparent lack of progress in the high-level waste disposal program began to be heard from a variety of sources, both in the US and internationally. There have been numerous papers and sessions at scientific conferences and several conferences devoted to this subject in the last three years. At the request of the US Department of Energy, the National Research Council is evaluating the feasibility of this concept. Because either plutonium or highly enriched uranium is needed to startup breeder reactors, there is a sound rationale for using Pu from reprocessing spent light-water reactor fuel to start a conversion to Pu-breeding liquid metal reactors (LMRs), once society makes the determination that adding a large component of LMRs to the electricity-generating grid is desirable. This is the long-term option referred to in the title. It is compatible with the current and likely future high-level waste program, as well as the current nuclear power industry in the US. However, the thesis of this paper is that partitioning and transmutation (P-T) does not offer a near term solution to high-level waste disposal in the US for numerous reasons, the most important of which is that a repository will be needed even with P-T. Other important reasons include: (1) lack of evidence that the public will be more likely to accept a repository that has a reduced inventory, (2) the waste disposal program delays do not result from technical evidence of lack of safety, (3) the economics of reprocessing and/or P-T are unfavorable, and (4) obtaining the benefits from P-T requires a long-term commitment to nuclear power.

25764 (UCRL-LR–107476-Vol.1) **Preliminary near-field environment report: Volume 1, Technical bases for EBS design.** Wilder, D.G. Lawrence Livermore National Lab., CA (United States). Apr 1993. 48p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93014854. Source: OSTI; NTIS; INIS; GPO Dep.

The United States Department of Energy (DOE) is investigating the suitability of Yucca Mountain as a potential site for the nation's first high-level nuclear waste repository. The site is located about 120 km northwest of Las Vegas, Nevada, in an area of uninhabited desert (Fig. 1). Lawrence Livermore National Laboratory (LLNL) is a Yucca Mountain Site Characterization Project (YMP) participant and is responsible for the development of waste package (WP) and engineered barrier system (EBS) design concepts, including materials testing and selection, design criteria development, waste-form characterization, performance assessments, and near-field environment (NFE) characterization.

25765 (WHC-EP–0182-55) **Tank farm surveillance and waste status summary report for October 1992.** Hanlon, B.M. Westinghouse Hanford Co., Richland, WA (United States). Jan 1993. 119p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE93014633. Source: OSTI; NTIS; INIS; GPO Dep.

This report is the official inventory for radioactive waste stored in underground tanks in the 200 Areas at the Hanford Site. Data that depict the status of stored radioactive waste and tank vessel integrity are contained within the report. This report provides data on each of the existing 177 large underground waste storage tanks and 49 smaller catch tanks and special surveillance facilities, and supplemental information regarding tank surveillance anomalies and ongoing investigations. This report is intended to meet the requirement of US Department of Energy-Richland Operations Office Order 5820.2A, Chapter 1, Section 3.e. (3) (DOE-RL, 1990, Radioactive Waste Management, US Department of Energy-Richland Operation Office, Richland, Washington) requiring the reporting of waste inventories and space utilization for Hanford Tank Farm Tanks.

25766 (WHC-EP–0182-56) **Tank farm surveillance and waste status summary report for November 1992.** Hanlon, B.M. Westinghouse Hanford Co., Richland, WA (United States). Feb 1993. 120p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE93014504. Source: OSTI; NTIS; INIS; GPO Dep.

This report is the official inventory for radioactive waste stored in underground tanks in the 200 Areas at the Hanford Site. Data that depict the status of stored radioactive waste and tank vessel integrity are contained within the report. This report provides data on each of the existing 177 large underground waste storage tanks and 49 smaller catch tanks and special surveillance facilities, and supplemental information regarding tank surveillance anomalies and ongoing investigations. This report is intended to meet the requirement of US Department of Energy-Richland Operations Office Order 5820.2A, Chapter 1, Section 3.e. (3) (DOE-RL, 1990, Radioactive Waste Management, US Department of Energy-Richland Operation Office, Richland, Washington) requiring the reporting of waste inventories and space utilization for Hanford Tank Farm Tanks.

25767 (WHC-EP–0182-57) **Tank farm surveillance and waste status summary report for December 1992.** Hanlon, B.M. Westinghouse Hanford Co., Richland, WA (United States). Feb 1993. 122p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE93014506. Source: OSTI; NTIS; INIS; GPO Dep.

This report is the official inventory for radioactive waste stored in underground tanks in the 200 Areas at the Hanford Site. Data that depict the status of stored radioactive waste and tank vessel integrity are contained within the report. This report provides data on each of the existing 177 large underground waste storage tanks and 49 smaller catch tanks and special surveillance facilities, and supplemental information regarding tank surveillance anomalies and ongoing investigations. This report is intended to meet the requirement of US Department of Energy-Richland Operations Office

Order 5820.2A, Chapter I, Section 3.e. (3) (DOE-RL, 1990, Radioactive Waste Management, US Department of Energy-Richland Operation Office, Richland, Washington) requiring the reporting of waste inventories and space utilization for Hanford Tank Farm Tanks.

25768 (WHC-EP–0461) **Action plan for responses to abnormal conditions in Hanford Site radioactive waste tanks with high organic content.** Turner, D.A. Westinghouse Hanford Co., Richland, WA (United States). Feb 1993. 24p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE93014487. Source: OSTI; NTIS; INIS; GPO Dep.

This action plan describes the criteria and the organizational responsibilities required for ensuring that waste tanks with high organic content are maintained in a safe condition at the Hanford Site. Additionally, response actions for prevention or mitigation of excessive temperature or a material release from any waste tank with high organic content have been outlined. Other response actions may be defined by Westinghouse Hanford Company Systems Engineering if a waste tank parameter goes out of specification. Trend analysis indicates the tank parameters have seasonal variation but are otherwise stable.

25769 (WHC-EP–0466-1-Rev.1) **Facility effluent monitoring plan for 242-A Evaporator facility: Revision 1.** Crummel, G.M.; Gustavson, R.D. Westinghouse Hanford Co., Richland, WA (United States). Mar 1993. 275p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE93014623. Source: OSTI; NTIS; INIS; GPO Dep.

A facility effluent monitoring plan is required by the US Department of Energy in DOE Order 5400.1* for any operations that involve hazardous materials and radioactive substances that could affect employee or public safety or the environment. A facility effluent monitoring plan determination was performed during Calendar Year 1991 and the evaluation showed the need for a facility effluent monitoring plan. This document is prepared using the specific guidelines identified in A Guide for Preparing Hanford Site Facility effluent Monitoring Plans, WHC-EP-0438-1**. This facility effluent monitoring plan assesses effluent monitoring systems and evaluates whether they are adequate to ensure the public health and safety as specified in applicable federal, state, and local requirements.

25770 (WHC-EP–0474-7) **Quarterly report on Defense Nuclear Facilities Safety Board Recommendation 90-7 for the period ending December 31, 1992.** Cash, R.J.; Dukelow, G.T.; Forbes, C.J. Westinghouse Hanford Co., Richland, WA (United States). Mar 1993. 115p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE93014631. Source: OSTI; NTIS; GPO Dep.

This is the seventh quarterly report on the progress of activities addressing safety issues associated with Hanford Site high-level radioactive waste tanks that contain ferrocyanide compounds. In the presence of oxidizing materials, such as nitrates or nitrites, ferrocyanide can be made to explode in the laboratory by heating it to high temperatures [above 285°C (545°F)]. In the mid 1950s approximately 140 metric tons of ferrocyanide were added to 24 underground high-level radioactive waste tanks. An implementation plan (Cash 1991) responding to the Defense Nuclear Facilities Safety Board Recommendation 90-7 (FR 1990) was issued in March 1991 describing the activities that were planned and underway to address each of the six parts of Recommendation 90-7. A revision to the original plan was transmitted to US Department of Energy by Westinghouse Hanford Company in December 1992. Milestones completed this quarter are described in this report. Contents of this report include: Introduction; Defense Nuclear Facilities Safety Board Implementation Plan Task Activities (Defense Nuclear Facilities Safety Board Recommendation for enhanced temperature measurement, Recommendation for continuous temperature monitoring, Recommendation for cover gas monitoring, Recommendation for ferrocyanide waste characterization, Recommendation for chemical reaction studies, and Recommendation for emergency response planning); Schedules; and References. All actions recommended by the Defense Nuclear Facilities Safety Board for emergency planning by Hanford Site emergency preparedness organizations have been completed.

25771 (WHC-EP–0532) **High heat tank safety issue resolution program plan.** DeFigh-Price, C.; Wang, O.S. Westinghouse Hanford Co., Richland, WA (United States). Feb 1993. 50p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE93014489. Source: OSTI; NTIS; INIS; GPO Dep.

The purpose of this program plan is to provide a guide for selecting corrective actions that with mitigate and/or resolve the single-shell tank 241-C-106 high-heat tank safety issue. This program plan also outlines the steps necessary to implement corrective actions. The postulated hazard for the high-heat tank safety issue involves the release of nuclear waste to the environment as the result of heat-induced structural damage to the tank's concrete, should forced cooling be interrupted for extended periods. The heat generation originates from the radioactive decay of waste material (primarily ^{90}Sr) that was inadvertently transferred into the tank in the late 1960s. Cooling to prevent waste temperatures in excess of the 300°F operating limit is currently accomplished by evaporative cooling through active filtered altered ventilation. This is supported by periodic water additions to maintain a liquid cover over the sludge, and for enhanced thermal conductivity for heat transfer.

25772 (WHC-EP–0569-Rev.1) **Long-term climate change assessment study plan for the Hanford Site Permanent Isolation Barrier Development Program: Revision 1.** Petersen, K.L. (Westinghouse Hanford Co., Richland, WA (United States)); Chatters, J.C.; Waugh, W.J. Westinghouse Hanford Co., Richland, WA (United States). May 1993. 71p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (PNL–8359). Order Number DE93014836. Source: OSTI; NTIS; INIS; GPO Dep.

The Hanford Site Permanent Isolation Barrier Development Program (Barrier Development Program) was organized to develop the technology needed to provide an in-place disposal capability for low-level nuclear waste for the US Department of Energy at the Hanford Site in south-central Washington. The goal of the Barrier Development Program is to provide defensible evidence that final barrier design(s) will adequately control water infiltration, plant and animal intrusion, and wind and water erosion for a minimum of 1,000 yr; to isolate wastes from the accessible environment; and to use markers to warn inadvertent human intruders. Evidence for barrier performance will be obtained by conducting laboratory experiments, field tests, computer modeling, and other studies that establish confidence in the barrier's ability to meet its 1,000-yr design life.

25773 (WHC-EP–0576) **Assessment of gas accumulation and retention – Tank 241-SY-101.** Alleman, R.T. (Pacific Northwest Lab., Richland, WA (US)); Burke, T.M.; Reynolds, D.A.; Simpson, D.E. Westinghouse Hanford Co., Richland, WA (United States). Mar 1993. 66p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE93014503. Source: OSTI; NTIS; INIS; GPO Dep.

An approximate analysis has been carried out to assess and estimate the maximum quantity of gas that is likely to be accumulated within waste tank 241-SY-101, and the maximum quantity which is likely to be retained after gas release events (GRE). According to the phenomenological models used for this assessment, based on interpretation of current and recent operational data, the estimated gas generation rate in the tank is approximately 4 m^3/day (147 ft^3/day). About half of this gas is released as it is generated, which is (essentially) continuously. The remainder is accumulated within the slurry layer of settled solids at the bottom of the tank, and released episodically in GREs, known as "burps," that are induced by unstable buoyant conditions which develop when sufficient gas accumulates in the slurry. Calculations based on gas volumes to cause neutral buoyancy in the slurry predict the following: the maximum gas accumulation (at 1 atm pressure) that can occur without triggering a GRE is in the range of 606 to 1,039 m^3 (21,400 to 36,700 ft^3); and the maximum gas retention immediately after a GRE is equal to the maximum accumulation minus the gas released in the GRE. GREs do not necessarily involve all of the slurry. In the largest GREs, which are assumed to involve all of

the slurry, the minimum gas release (at 1 atm pressure) is calculated to be in the range of 193 to 328 m^3 (6,800 to 11,600 ft^3). The corresponding maximum gas retention would be 413 to 711 m^3 (14,600 to 25,100 ft^3).

25774 (WHC-EP–0621) **Characterization of past and present solid waste streams from the plutonium finishing plant.** Duncan, D.R. (Westinghouse Hanford Co., Richland, WA (United States)); Mayancsik, B.A.; Pottmeyer, J.A.; Vejvoda, E.J.; Reddick, J.A.; Sheldon, K.M.; Weyns, M.I. Westinghouse Hanford Co., Richland, WA (United States). Feb 1993. 487p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE93014186. Source: OSTI; NTIS; INIS; GPO Dep.

During the next two decades the transuranic (TRU) wastes now stored in the burial trenches and storage facilities at the Hanford Site are to be retrieved, processed at the Waste Receiving and Processing (WRAP) Facility, and shipped to the Waste Isolation Pilot Plant (WIPP) near Carlsbad, New Mexico for final disposal. Over 50% of the TRU waste to be retrieved for shipment to the WIPP has been generated at the Plutonium Finishing Plant (PFP), also known as the Plutonium Processing and Storage Facility and Z Plant. The purpose of this report is to characterize the radioactive solid wastes generated by the PFP since its construction in 1947 using process knowledge, existing records, and history-obtained from interviews. The PFP is currently operated by Westinghouse Hanford Company (WHC) for the US Department of Energy (DOE).

25775 (WHC-EP–0628) **Tank 101-SY Window E core sample: Interpretation of results.** Reynolds, D.A. Westinghouse Hanford Co., Richland, WA (United States). Feb 1993. 90p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE93014486. Source: OSTI; NTIS; INIS; GPO Dep.

A full depth core sample was taken for tank 241-SY-101 in December 1991 during a time period called "Window E." This was the second full depth core sample from this tank during the year. The core had two major portions that are known as the convective zone and the nonconvective zone. A crust was on the top of tank but as poorly sampled. The analysis of the Window E core sample stressed segment composite chemical analysis instead of segment by segment as in Window C. Adiabatic calorimetry on samples from both cores showed a slow self heating reaction above 150°C on dried samples. The exothermic events were milder than similar synthetic samples. The chemical and physical properties complemented the information from Window C. The Window E material from the convective zone was more viscous than the Window C convective zone material. The nonconvective zone viscosities were similar for both cores. Heating and dilution tests were made to test mitigation concepts.

25776 (WHC-EP–0631) **Ferrocyanide waste simulant characterization.** Jeppson, D.W.; Wong, J.J. Westinghouse Hanford Co., Richland, WA (United States). Jan 1993. 403p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE93014616. Source: OSTI; NTIS; INIS; GPO Dep.

Ferrocyanide waste simulants were prepared and characterized to help assess safety concerns associated with the ferrocyanide sludges stored in underground single-shell waste tanks at the Hanford Site. Simulants were prepared to represent the variety of ferrocyanide sludges stored in the storage tanks. Physical properties, chemical compositions, and thermodynamic properties of the simulants were determined. The simulants, as produced, were shown to not sustain propagating reactions when subjected to a strong ignition source. Additional testing and evaluations are recommended to assess safety concerns associated with postulated ferrocyanide sludge dry-out and exposure to external ignition sources.

25777 (WHC-EP–0635) **Assay development status report for total cyanide.** Simpson, B.C. (Westinghouse Hanford Co., Richland, WA (United States)); Jones, T.E.; Pool, K.H. Westinghouse Hanford Co., Richland, WA (United States). Feb 1993. 60p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE93014628. Source: OSTI; NTIS; INIS; GPO Dep.

A validated cyanide assay that is applicable to a variety of tank waste matrices is necessary to resolve certain waste tank safety issues and for purposes of overall waste characterization. The target for this effort is an assay with an applicable range of greater than 1,000 ppM (0.10 wt%) total cyanide and a confidence level greater than 80%. Figure 1 illustrates the operating regime of the proposed cyanide assay method. The Assay Development Status Report for Total Cyanide will summarize the past experience with cyanide analyses on-tank waste matrices and will rate the status of the analytical methods used to assay total cyanide (CN^- ion) in the tank waste matrices as acceptable or unacceptable. This paper will also briefly describe the current efforts for improving analytical resolution of the assays and the attempts at speciation.

25778 (WHC-EP–0646) **Characterization of past and present solid waste streams from the Plutonium-Uranium Extraction Plant.** Pottmeyer, J.A. (Los Alamos Technical Associates, Inc., NM (US)); Weyns, M.I.; Lorenzo, D.S.; Vejvoda, E.J.; Duncan, D.R. Westinghouse Hanford Co., Richland, WA (United States). Apr 1993. 436p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE93016829. Source: OSTI; NTIS; INIS; GPO Dep.

During the next two decades the transuranic wastes, now stored in the burial trenches and storage facilities at the Hanford Site, are to be retrieved, processed at the Waste Receiving and Processing Facility, and shipped to the Waste Isolation Pilot Plant near Carlsbad, New Mexico for final disposal. Over 7% of the transuranic waste to be retrieved for shipment to the Waste Isolation Pilot Plant has been generated at the Plutonium-Uranium Extraction (PUREX) Plant. The purpose of this report is to characterize the radioactive solid wastes generated by PUREX using process knowledge, existing records, and oral history interviews. The PUREX Plant is currently operated by the Westinghouse Hanford Company for the US Department of Energy and is now in standby status while being prepared for permanent shutdown. The PUREX Plant is a collection of facilities that has been used primarily to separate plutonium for nuclear weapons from spent fuel that had been irradiated in the Hanford Site's defense reactors. Originally designed to reprocess aluminum-clad uranium fuel, the plant was modified to reprocess zirconium alloy clad fuel elements from the Hanford Site's N Reactor. PUREX has provided plutonium for research reactor development, safety programs, and defense. In addition, the PUREX was used to recover slightly enriched uranium for recycling into fuel for use in reactors that generate electricity and plutonium. Section 2.0 provides further details of the PUREX's physical plant and its operations. The PUREX Plant functions that generate solid waste are as follows: processing operations, laboratory analyses and supporting activities. The types and estimated quantities of waste resulting from these activities are discussed in detail.

25779 (WHC-EP–0648) **Ferrocyanide safety program: Credibility of drying out ferrocyanide tank waste by hot spots.** Dickinson, D.R.; McLaren, J.M.; Borsheim, G.L.; Crippen, M.D. Westinghouse Hanford Co., Richland, WA (United States). Apr 1993. 73p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE93014619. Source: OSTI; NTIS; INIS; GPO Dep.

The single-shell waste tanks at the Hanford Site that contain significant quantities of ferrocyanide have been considered a possible hazard, since under certain conditions the ferrocyanide in the waste tanks could undergo an exothermic chemical reaction with the nitrates and nitrites that are also present in the tanks. The purpose of this report is to assess the credibility of local dryout of ferrocyanide due to a hotspot. This report considers the following: What amount of decay heat generation within what volume would be necessary to raise the temperature of the liquid in the sludge to its boiling point? What mechanisms could produce a significant local concentration of heat sources? Is it credible that a waste tank heat concentration could be as large as that required to reach the dryout temperatures? This report also provides a recommendation as to whether infrared scanning of the ferrocyanide tanks is needed. From the analyses presented in this report it is evident that formation of dry, and thus chemically reactive, regions in the ferrocyanide

sludge by local hotspots is not credible. This conclusion is subject to reevaluation if future analyses of tank core samples show much higher ^{137}Cs or ^{90}Sr concentrations than expected. Since hotspots of concern are not credible, infrared scanning to detect such hotspots is not required for safe storage of tank waste.

25780 (WHC-EP–0655-Draft) **Parametric study of radionuclide characterization – Low-level waste: Draft.** Amir, S.J. Westinghouse Hanford Co., Richland, WA (United States). Apr 1993. 88p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE93014140. Source: OSTI; NTIS; INIS; GPO Dep.

The criteria and guidance given in this addendum specifically address the classification of low-level waste at the Hanford Reservation into Category 1, Category 3, and Greater Than Category 3 (GTC3). These categories are developed based on the performance assessment (PA) being conducted for the Hanford Site. The radionuclides and their concentration for each category are listed in the revised Table 1-1 (Attachment 1). The information to classify the waste for US Department of Transportation (DOT) and to classify Transuranic (TRU)/Non-TRU, Contact Handled (CH)/Remote Handled (RH) waste is given in WHC-EP-0063-3 (WHC 1991).

25781 (WHC-EP–0658) **Moisture monitoring of ferrocyanide tanks: An evaluation of methods and tools.** Meacham, J.E.; Babad, H.; Toffer, H. Westinghouse Hanford Co., Richland, WA (United States). Apr 1993. 46p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE93014634. Source: OSTI; NTIS; INIS; GPO Dep.

This report reviews the strengths and limitations of moisture monitoring technologies that could be used for determining moisture concentration in Hanford Site single-shell ferrocyanide waste tanks. Two technologies (neutron diffusion and near-infrared spectroscopy) are being pursued as part of the ferrocyanide program. A third technology, Raman spectroscopy, is in development as a speciation tool at the Westinghouse Hanford Company 222-S Laboratory. The potential application of Raman spectroscopy to moisture monitoring is discussed.

25782 (WHC-EP–0659) **Characterization of past and present solid waste streams from 231-Z.** Pottmeyer, J.A. (Los Alamos Technical Associates, Inc., NM (US)); DeLorenzo, D.S.; Weyns-Rollosson, M.I.; Berkwitz, D.E.; Vejvoda, E.J.; Duncan, D.R. Westinghouse Hanford Co., Richland, WA (United States). Jun 1993. 191p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE93016826. Source: OSTI; NTIS; INIS; GPO Dep.

During the next two decades the transuranic (TRU) wastes now stored in the burial trenches and storage facilities at the Hanford Site are to be retrieved, processed at the Waste Receiving and Processing Facility, and shipped to the Waste Isolation Pilot Plant near Carlsbad, New Mexico for final disposal. Over 8% of the TRU waste to be retrieved for shipment to the Waste Isolation Pilot Plant has been generated at the Plutonium Metallurgy Laboratory (231-Z) Facility. The purpose of this report is to characterize the radioactive solid wastes generated by 231-Z using process knowledge, existing records and oral history interviews. Since 1944 research and development programs utilizing plutonium have been conducted at 231-Z in the fields of physical metallurgy, property determination, alloy development, and process development. The following are sources of solid waste generation at the 231-Z Facility: (1) General Weapons Development Program, (2) process waste from gloveboxes, (3) numerous classified research and development programs, (4) advanced decontamination and decommissioning technologies, including sectioning, vibratory finishing, electropolishing, solution process, and small bench-scale work, (5) general laboratory procedures, (6) foundry area, (7) housekeeping activities, and (8) four cleanout campaigns. All solid wastes originating at 231-Z were packaged for onsite-offsite storage or disposal. Waste packaging and reporting requirements have undergone significant changes throughout the history of 231-Z. Current and historical procedures are provided in Section 4.0. Information on the radioactive wastes generated at 231-Z can be found in a number of documents and databases, most importantly the Solid Waste Information and Tracking System database and Solid Waste Burial Records. Facility personnel also provide excellent information about past waste generation and the procedures used to handle that waste. Section 5.0 was compiled using these sources.

25783 (WHC-SA–1423) **Managing Hanford Site solid waste through strict acceptance criteria.** Jasen, W.G.; Pierce, R.D.; Willis, N.P. Westinghouse Hanford Co., Richland, WA (United States). Feb 1993. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (CONF-930205–65: Waste management '93, Tucson, AZ (United States), 28 Feb - 4 mar 1993). Order Number DE93014190. Source: OSTI; NTIS; INIS; GPO Dep.

Various types of waste have been generated during the 50-year history of the Hanford Site. Regulatory changes in the last 20 years have provided the emphasis for better management of these wastes. Interpretations of the Atomic Energy Act of 1954 (AEA) and the Resource Conservation and Recovery Act of 1976 (RCRA) have led to the definition of a group of wastes called radioactive mixed wastes (RMW). As a result of the radioactive and hazardous properties of these wastes, strict management programs have been implemented for the management of these wastes. Solid waste management is accomplished through a systems performance approach to waste management that used best-demonstrated available technology (BDAT) and best management practices. The solid waste program at the Hanford Site strives to integrate all aspects of management relative to the treatment, storage and disposal (TSD) of solid waste. Often there are many competing and important needs. It is a difficult task to balance these needs in a manner that is both equitable and productive. Management science is used to help the process of making decisions. Tools used to support the decision making process include five-year planning, cost estimating, resource allocation, performance assessment, waste volume forecasts, input/output models, and waste acceptance criteria. The purpose of this document is to describe how one of these tools, waste acceptance criteria, has helped the Hanford Site manage solid wastes.

25784 (WHC-SA–1551) **Nondestructive assay of boxed radioactive waste.** Gilles, W.P.; Roberts, R.J.; Jasen, W.G. Westinghouse Hanford Co., Richland, WA (United States). Dec 1992. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (CONF-930906–6: '93 international conference on nuclear waste management and environmental remediation, Prague (Czech Republic), 5-11 Sep 1993). Order Number DE93009430. Source: OSTI; NTIS; INIS; GPO Dep.

This paper describes the problems related to the nondestructive assay (NDA) of boxed radioactive waste at the Hanford Site and how Westinghouse Hanford company (WHC) is solving the problems. The waste form and radionuclide content are described. The characteristics of the combined neutron and gamma-based measurement system are described.

25785 (WHC-SA–1608) **Radioactive mixed waste disposal.** Jasen, W.G.; Erpenbeck, E.G. Westinghouse Hanford Co., Richland, WA (United States). Feb 1993. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (CONF-930906–4: '93 international conference on nuclear waste management and environmental remediation, Prague (Czech Republic), 5-11 Sep 1993). Order Number DE93009425. Source: OSTI; NTIS; INIS; GPO Dep.

Various types of waste have been generated during the 50-year history of the Hanford Site. Regulatory changes in the last 20 years have provided the emphasis for better management of these wastes. Interpretations of the Atomic Energy Act of 1954 (AEA), the Resource Conservation and Recovery Act of 1976 (RCRA), and the Hazardous and Solid Waste Amendments (HSWA) have led to the definition of radioactive mixed wastes (RMW). The radioactive and hazardous properties of these wastes have resulted in the initiation of special projects for the management of these wastes. Other solid wastes at the Hanford Site include low-level wastes, transuranic (TRU), and nonradioactive hazardous wastes. This paper describes a system for the treatment, storage, and disposal (TSD) of solid radioactive waste.

25786 (WHC-SA–1609) **Mobile inspection and repackaging unit.** Whitney, G.A.; Roberts, R.J. Westinghouse Hanford Co.,

Richland, WA (United States). Dec 1992. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (CONF-930906–5: '93 international conference on nuclear waste management and environmental remediation, Prague (Czech Republic), 5-11 Sep 1993). Order Number DE93009431. Source: OSTI; NTIS; INIS; GPO Dep.

Storage of large volumes of radioactive mixed waste (RMW) and transuranic waste generated over the past 20 years at the Hanford Site has resulted in various waste management challenges. Presently disposal capacity for this waste type does not exist. The waste wail be stored until processing facilities can be completed to provide treatment and final disposed. Because of the complexity of these wastes, special projects have been initiated to properly manage them. This paper addresses one such project. The goal of this project is to develop a mobile solid waste inspection and repackaging facility for solid RMW and transuranic waste.

25787 (WHC-SA–1623) **Vadose zone characterization of highly radioactive contaminated soil at the Hanford Site.** Buckmaster, M.A. Westinghouse Hanford Co., Richland, WA (United States). May 1993. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (CONF-930906–10: '93 international conference on nuclear waste management and environmental remediation, Prague (Czech Republic), 5-11 Sep 1993). Order Number DE93014916. Source: OSTI; NTIS; INIS; GPO Dep.

The Hanford Site in south-central Washington State contains over 1500 identified waste sites and numerous groundwater plumes that will be characterized and remediated over the next 30 years. As a result of the Hanford Federal Facility Agreement and Consent Order, the US Department of Energy has initiated a remedial investigation/feasibility study at the 200-BP-1 operable unit. The 200-BP-1 remedial investigation is the first Comprehensive Environmental Response, Compensation, and Liability Act of 1980 investigation on the Hanford Site that involves drilling into highly radioactive and chemically contaminated soils. The initial phase of site characterization was designed to assess the nature and extent of contamination associated with the source waste site within the 200-BP-1 operable unit. Characterization activities consisted of drilling and sampling the waste site, chemical and physical analysis of samples, and development of a conceptual vadose zone model. Predicted modeling concentrations compared favorably to analytical data collected during the initial characterization activities.

25788 (WHC-SA–1630) **In situ electrochemical characterization of grouted radioactive waste.** Gu, Jingyan (Brooklyn Coll., NY (United States). Dept. of Physics); Shen, Wu-Mian; Tomkiewicz, Micha; Kruger, A.A. Westinghouse Hanford Co., Richland, WA (United States). Apr 1993. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (CONF-930906–9: '93 international conference on nuclear waste management and environmental remediation, Prague (Czech Republic), 5-11 Sep 1993). Order Number DE93014505. Source: OSTI; NTIS; INIS; GPO Dep.

At the Hanford Site, twenty-eight double-shell tanks (DST) and one hundred and forty nine single-shell tanks (SST) are used for storage of radioactive liquid and sludge wastes and sat cake. A fundamental goal of the Westinghouse Hanford Company is to end the current storage practice for liquid wastes and to permanently dispose of the waste. The Hanford Defense Waste Environmental Impact Statement and subsequent record of decision has identified a cement-based waste form for disposal of DST low-level liquid waste. The low level radioactive fractions of these wastes will be immobilized in a cementitious grout at the Hanford Grout Processing Facility and disposed of in concrete vaults of the Grout Disposal Facility. Prior to closing each vault, postcuring verification will show that the final product meets the performance requirements. Any long term disposal system of radioactive waste will require monitoring to warn against structural deterioration and/or leach of the radioactive or hazardous components into the environment. We are investigating the possibility of monitoring the degree of immobilization of the waste by embedding a grid of long-lasting electrodes in grout. This work describes our ongoing attempts to understand the physics and chemistry of charge carriers in the grout under various load conditions.

25789 (WHC-SA–1637) **FT-IR analyses of the oxidative decomposition products of cyanoferrate wastes.** Rebagay, T.V.; Dodd, D.A.; Colby, S.A. Westinghouse Hanford Co., Richland, WA (United States). Mar 1993. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (CONF-930313–2: 44. Pittsburgh conference and exposition on analytical chemistry and applied spectroscopy, Atlanta, GA (United States), 8-12 Mar 1993). Order Number DE93014589. Source: OSTI; NTIS; INIS; GPO Dep.

The Hanford Site (Fig. 1) near Richland, Washington, operated by the US Department of Energy, Richland Field Office, had produced nuclear materials for the nation's defense programs for more than 50 years. The radioactive liquid waste resulting from the processing of irradiated nuclear materials is stored temporarily in single-shell carbon steel tanks (Fig. 2) at the Site. The tanks are buried underground in tank farms with several feet of soil cover above the tank closure (Fig. 3). As part of a program to conserve tank space in the 1950s', a precipitation process was developed to scavenge radioactive cesium from the waste supernates. Ferrocyanide was added to the radioactive wastes and cesium-depleted supernates were discharged into cribs. Hexacyanoferrates [$Fe(CN)_6^{3-}$ and $Fe(CN_6^{4-}$] are generally considered to be extraordinarily stable and even called-kinetically inert. However, recent 2 safety concerns have focused on the stability of cyanoferrate-bearing tanks containing large quantities of nitrates and nitrites. One strategy to resolve this concern involves oxidative decomposition of the cyanoferrates with common oxidants such as ozone (O_3) and hydrogen peroxide. This paper describes the results of the initial studies on the treatment of simulated cyanoferrate wastes with ozone and ozone-hydrogen peroxide mixtures. The oxidative decomposition products were analyzed by a Fourier transform infrared spectroscopic method.

25790 (WHC-SA–1661) **A strategy for resolving high-priority Hanford Site radioactive waste storage tank safety issues.** Babad, H.; DeFigh-Price, C.; Fulton, J.C. Westinghouse Hanford Co., Richland, WA (United States). Feb 1993. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (CONF-930205–72: Waste management '93, Tucson, AZ (United States), 28 Feb - 4 mar 1993). Order Number DE93014626. Source: OSTI; NTIS; INIS; GPO Dep.

High-activity radioactive waste has been stored in large underground storage tanks at the US Department of Energy's (DOE) Hanford Site in Eastern Washington State since 1944. Since then, more than 227,000 m^3 (60 Mgal) of waste have been accumulated in 177 tanks. These caustic wastes consist of many different chemicals. The waste forms include liquids, slurries, salt cakes, and sludges. A number of safety issues have been raised about these wastes, and resolution of these issues is a top priority of DOE. A Waste Tank Safety Program has been established to resolve these high-priority safety issues. This paper will deal with three of these issues. The issues described are the release of flammable vapors from single- and double-shell tanks, the existence of organic chemicals, and/or ferrocyanide ion-containing fuel-rich mixtures of nitrate and nitrite salts in single-shell tanks.

25791 (WHC-SA–1671) **Resolving the safety issue for radioactive waste tanks with high organic content.** Babad, H. (Westinghouse Hanford Co., Richland, WA (United States)); Crippen, M.D.; Turner, D.A.; Gerber, M.A. Westinghouse Hanford Co., Richland, WA (United States). Feb 1993. 22p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (CONF-930205–71: Waste management '93, Tucson, AZ (United States), 28 Feb - 4 mar 1993). Order Number DE93014627. Source: OSTI; NTIS; INIS; GPO Dep.

An overview of the Waste Tank Safety Organic Program is provided. The overview discusses the history of the wastes containing high concentrations of organics, existing safety criteria associated with those tanks, and details of thermodynamic studies by Westinghouse Hanford Company bounding potential reactivity. The program to be discussed contains the elements of the collection and analysis of tank historical information; reevaluation of organic tank-listing criteria; the performance of detailed studies on simulated waste; completion of waste characterization for each affected tank; and, as part of issue closure, the preparation of short-term and long-term

safety and risk assessments based on results from characterization and the waste simulant studies. This document reports on a number of simplified thermodynamic calculations that were performed to ascertain combustion limits for simple surrogates of organic materials in a nitrate-nitrite containing alkaline waste. For expected waste species, the results of these calculations indicate that the range of reactivity encompasses energies that vary only by a factor of three over the range of normal paraffin hydrocarbon (NPH) (a fuel rich solvent) to sodium oxalate (a degradation product resulting from in situ organic complexant destruction in Hanford Site wastes).

25792 (WHC-SA–1694) **Tank waste chemistry: A new understanding of waste aging.** Babad, H. (Westinghouse Hanford Co., Richland, WA (United States)); Camaioni, D.M.; Lilga, M.A.; Samuels, W.D.; Strachan, D.M. Westinghouse Hanford Co., Richland, WA (United States). Feb 1993. 21p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (CONF-930205–70: Waste management '93, Tucson, AZ (United States), 28 Feb - 4 mar 1993). Order Number DE93014625. Source: OSTI; NTIS; INIS; GPO Dep.

There is concern about the risk of uncontrolled exothermic reaction(s) in Hanford Site waste tanks containing NO_3^-/NO_2 based salts and/or metal hydroxide sludges in combination with organics or ferrocyanides. However, gradual oxidation of the waste in the tanks to less reactive species appears to have reduced the risk. In addition, wastes sampled to date contain sufficiently large quantities of water so that propagation reactions are highly unlikely. This paper investigates various aspects of the aging of Hanford tank wastes.

25793 (WHC-SA–1697) **Tank waste retrieval issues and options for their resolution.** Miller, W.C. (Westinghouse Savannah River Co., Aiken, SC (United States)); Henderson, J.M.; Shen, E.J.; Stegen, L.C.; Wrzesinski, W.R. Westinghouse Savannah River Co., Aiken, SC (United States). Feb 1993. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (CONF-930205–68: Waste management '93, Tucson, AZ (United States), 28 Feb - 4 mar 1993). Order Number DE93014488. Source: OSTI; NTIS; INIS; GPO Dep.

The US Department of Energy has undertaken the significant challenge of remediating the high-level wastes currently being stored underground in tanks located at the Hanford Site in Washington State. A key element of the remediation process is the recovery of these defense production wastes in preparation for downstream processing and disposal. A number of technical and programmatic issues have been identified with the waste recovery process, referred to as retrieval. In response to these issues, a retrieval strategy has been developed that addresses the need to meet legal obligations and balances the technology development needs. This strategy has been embodied into a retrieval plan, which has looked at numerous retrieval system approaches and establishes a basis for development of the selected systems. The strategy and plan are evolutionary in approach, with the ability to change when waste properties are better understood, key decisions are negotiated, and lessons learned are available from initial retrieval efforts.

25794 (WHC-SA–1701) **Recent results from characterization of ferrocyanide wastes at the Hanford Site.** Simpson, B.C.; Babad, H.; Cash, R.J. Westinghouse Hanford Co., Richland, WA (United States). Feb 1993. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (CONF-930205–67: Waste management '93, Tucson, AZ (United States), 28 Feb - 4 mar 1993). Order Number DE93014491. Source: OSTI; NTIS; INIS; GPO Dep.

Public Law 101-510, Section 3137, "Safety Measures for Waste Tanks at Hanford Nuclear Reservation," (1) requires that Westinghouse Hanford Company develop plans to resolve safety issues for tanks that could experience excessive temperature changes or pressure increases, resulting in a release of radioactive material from any high-level waste tank at the Hanford Site. Fifty-three tanks have been identified and categorized by tank contents. These include tanks that (a) contain ferrocyanide compounds, (b) have the potential for flammable gas generation, (c) contain organics, or (d) have high-heat loads. The ferrocyanide and hydrogen gas safety issues have been declared unreviewed safety questions (USQs) because postulated accident scenarios may fall outside safety envelopes defined by existing safety analysis documentation (2). Both USQ issues were reported at Waste Management '92 (3, 4). Detailed research has been conducted to provide insight into the severity of the ferrocyanide tank safety issue. Work included waste characterization and investigation of the energetic behavior of ferrocyanide waste material. The data presented will focus on "In-Farm" simulant studies and information from tank 241-C-112, core samples 34 and 36.

25795 (WHC-SA–1708) **Low-level waste disposal - Grout issue and alternative waste form technology.** Epstein, J.L. (Westinghouse Hanford Co., Richland, WA (United States)); Westski, J.H. Jr. Westinghouse Hanford Co., Richland, WA (United States). Feb 1993. 21p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (CONF-930205–69: Waste management '93, Tucson, AZ (United States), 28 Feb - 4 mar 1993). Order Number DE93014485. Source: OSTI; NTIS; INIS; GPO Dep.

Based on the Record of Decision (1) for the Hanford Defense Waste Environmental Impact Statement (HDW-EIS) (2), the US Department of Energy (DOE) is planning to dispose of the low-level fraction of double-shell tank (DST) waste by solidifying the liquid waste as a cement-based grout placed in near-surface, reinforced, lined concrete vaults at the Hanford Site. In 1989, the Hanford Grout Disposal Program (HGDP) completed a full-scale demonstration campaign by successfully grouting 3,800 cubic meters (1 million gallons) of low radioactivity, nonhazardous, phosphate/sulfate waste (PSW), mainly decontamination solution from N Reactor. The HGDP is now preparing for restart of the facility to grout a higher level activity, mixed waste double-shell slurry feed (DSSF). This greater radionuclide and hazardous waste content has resulted in a number of issues confronting the disposal system and the program. This paper will present a brief summary of the Grout Treatment Facility's components and features and will provide a status of the HGDP, concentrating on the major issues and challenges resulting from the higher radionuclide and hazardous content of the waste. The following major issues will be discussed: Formulation (cementitious mix) development; the Performance Assessment (PA) (3) to show compliance of the disposal system to long-term environmental protection objectives; and the impacts of grouting on waste volume projections and tank space needs.

25796 (WHC-SA–1729) **The impact of safety analyses on the design of the Hanford Waste Vitrification Plant.** Koppenaal, T.J. (WasteChem Corp., Irvine, CA (United States)); Yee, A.K.; Reisdorf, J.B.; Hall, B.W. Westinghouse Hanford Co., Richland, WA (United States). Apr 1993. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (CONF-930408–80: International high-level radioactive waste management conference, Las Vegas, NV (United States), 25-29 Apr 1993). Order Number DE93016478. Source: OSTI; NTIS; INIS; GPO Dep.

Accident analyses are being performed to evaluate and document the safety of the Hanford Waste Vitrification Plant (HWVP). The safety of the HWVP is assessed by evaluating worst-case accident scenarios and determining the dose to offsite and onsite receptors. Air dispersion modeling is done with the GENII computer code. Three accidents are summarized in this paper, and their effects on the safety and the design of the HWVP are demonstrated.

25797 (WHC-SA–1735) **Tolerancing requirements for remote handling at the Hanford Waste Vitrification Plant.** Van Katwijk, C. (Westinghouse Hanford Co., Richland, WA (United States)); Keenan, R.M.; Bullis, R.E. Westinghouse Hanford Co., Richland, WA (United States). [1993]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (CONF-930408–67: International high-level radioactive waste management conference, Las Vegas, NV (United States), 25-29 Apr 1993). Order Number DE93011277. Source: OSTI; NTIS; INIS; GPO Dep.

The Hanford Waste Vitrification Plant (HWVP) is being designed by Fluor Daniel, Inc. with Waste Chem Corporation as Fluor Daniel, Inc.'s major subcontractor specializing in vitrification and remote system technologies. United Engineers and Constructors (UE&C)/ Catalytic (UCAT) will construct the plant. Westinghouse Hanford

Company is the Project Integration manager and Business manager, and as the plant operator it provides technical direction to the Architect/Engineer team (A/E) and constructor on behalf of the US Department of Energy - Richland Field Office. The A/E has developed, in cooperation with UE&C, Westinghouse Hanford Company, and the US Department of Energy, a new and innovative approach to installations of the many remote nozzles and electrical connectors that must be installed to demanding tolerances. This paper summarizes the key elements of the HWVP approach.

25798 (WHC-SA–1748) **Waste separations and pretreatment technology development in the Underground Storage Tank–Integrated Demonstration Program.** Cruse, J.M. Westinghouse Hanford Co., Richland, WA (United States). Apr 1993. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (CONF-930702–25: Pressure vessels and piping conference, Denver, CO (United States), 25-29 Jul 1993). Order Number DE93014189. Source: OSTI; NTIS; INIS; GPO Dep.

The principal objective of the Underground Storage Tank Integrated Demonstration (UST-ID) Program is the demonstration and continued development of technologies suitable for the remediation of USTs. The most promising new technologies are selected for demonstration, testing, and evaluation. The objective is the eventual transfer of new technologies as a system to full-scale remediation at US Department of Energy (DOE) complexes and sites in the private sector. Technologies under development in the UST-ID Program are targeted toward use in remediation actions at the following five DOE participant sites: Hanford, Fernald, Idaho, Oak Ridge, and Savannah River. Combined, these participant sites have more than 300 USTs containing more than 100 m gal of high-level and low-level radioactive liquid waste. This paper focuses on the Waste Separations and Pretreatment area of the UST-ID, summarizing the currently funded technology development projects. In this area, several "compact processing units" (CPUs) are being developed to effect near-term demonstration and deployment of promising processes in actual tank environments. The CPU design and development approach is summarized. A number of programmatic issues are discussed, including onsite and offsite transportation of potentially contaminated processing systems, containment design criteria, including applicable codes and standards, and operation and maintenance of such systems in a developmental testing environment.

25799 (WHC-SA–1788) **Design of the Waste Receiving and Processing Module 2A Facility.** Lamberd, D.L. Westinghouse Hanford Co., Richland, WA (United States). Mar 1993. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (CONF-930873–5: 2. international mixed waste symposium, Baltimore, MD (United States), 17-20 Aug 1993). Order Number DE93012611. Source: OSTI; NTIS; INIS; GPO Dep.

Westinghouse Hanford Company has determined that a facility is required for the treatment of mixed low-level waste at the Hanford Site. The mission of that facility will be to receive, process/treat, package, certify, and ship the contact-handled, mixed low-level waste that must be handled by Hanford Site to permanent disposal. Preconceptual and conceptual design studies were performed by United Engineers and Constructors, and a conceptual design report was issued. This report presents a summary of the conceptual design for a facility that will meet the mission established.

25800 (WHC-SA–1789) **An approach for sampling solid heterogeneous waste at the Hanford Site waste receiving and processing and solid waste projects.** Sexton, R.A. Westinghouse Hanford Co., Richland, WA (United States). Mar 1993. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (CONF-930873–10: 2. international mixed waste symposium, Baltimore, MD (United States), 17-20 Aug 1993). Order Number DE93013002. Source: OSTI; NTIS; INIS; GPO Dep.

This paper addresses the problem of obtaining meaningful data from samples of solid heterogeneous waste while maintaining sample rates as low as practical. The Waste Receiving and Processing Facility, Module 1, at the Hanford Site in south-central Washington State will process mostly heterogeneous solid wastes. The presence of hazardous materials is documented for some packages and unknown for others. Waste characterization is needed to segregate the waste, meet waste acceptance and shipping requirements, and meet facility permitting requirements. Sampling and analysis are expensive, and no amount of sampling will produce absolute certainty of waste contents. A sampling strategy is proposed that provides acceptable confidence with achievable sampling rates.

25801 (WHC-SA–1795) **Low-level radioactive mixed waste land disposal facility – Permanent disposal.** Erpenbeck, E.G.; Jasen, W.G. Westinghouse Hanford Co., Richland, WA (United States). Mar 1993. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (CONF-930873–14: 2. international mixed waste symposium, Baltimore, MD (United States), 17-20 Aug 1993). Order Number DE93012616. Source: OSTI; NTIS; INIS; GPO Dep.

Radioactive mixed waste (RMW) disposal at US Department of Energy (DOE) facilities is subject to the Resource Conservation and Recovery Act of 1976 (RCRA) and the Hazardous and Solid Waste Amendments of 1984 (HSWA). Westinghouse Hanford Company, in Richland, Washington, has completed the design of a radioactive mixed waste land disposal facility, which is based on the best available technology compliant with RCRA. When completed, this facility will provide permanent disposal of solid RMW, after treatment, in accordance with the Land Disposal Restrictions. The facility includes a double clay and geosynthetic liner with a leachate collection system to minimize potential leakage of radioactive or hazardous constituents from the landfill. The two clay liners will be capable of achieving a permeability of less than 1×10^{-7} cm/s. The two clay liners, along with the two high density polyethylene (HDPE) liners and the leachate collection and removal system, provide a more than conservative, physical containment of any potential radioactive and/or hazardous contamination.

25802 (WHC-SA–1810) **Time and motion simulation of the WRAP Module 1 Facility.** Van Zanten, K.D. (United Engineers and Constructors, Inc., Denver, CO (United States)); Weidert, J.R. Westinghouse Hanford Co., Richland, WA (United States). Feb 1993. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (CONF-930205–60: Waste management '93, Tucson, AZ (United States), 28 Feb - 4 mar 1993). Order Number DE93011274. Source: OSTI; NTIS; INIS; GPO Dep.

A Time and Motion simulation model was developed for the Waste Receiving and Processing (WRAP) Module 1 Facility which will be located at the Hanford site. The simulation model was developed using the WITNESS computer program licensed from AT&T ISTEL. The model simulates the movement of 6,825 drums per year of transuranic (TRU) and low level waste (LLW) through the WRAP 1 Facility. In the WRAP 1 Facility, four main areas were modeled: Receiving, Non-Destructive Examination/Non-Destructive Assay (NDE/NDA), Waste Process and Shipping. Movement of waste drums through the plant is accomplished with forklifts, roller conveyors, two automated guided vehicles (AGV's), lift tables, jib cranes and pallet transfer carts. In-plant drum storage is provided by an automated storage and retrieval system (ASRS) for palletized drums in the Receiving/Shipping areas, a 12-drum storage carousel in the NDE/NDA area and a 24-drum storage carousel in the Waste Process area. The process simulation models use a color graphic display of plant operations to show drum (or pallet) movement throughout the plant. Actual speeds of vehicles, conveyors and forklifts are simulated in the model as well as machine cycle times, delay times, and stop times. Vehicle load and unload times, and acceleration and deceleration are included in the model. Distributions for the arrival of trucks delivering pallets or trucks leaving with waste drums or pallets are included in the model. Random numbers for distributions are assigned to determine the effect of variability on plant performance. The simulation program generates a full range of reports that allows users to determine the plant throughput under a wide variety of conditions. Typically a warm-up period is run to allow drums to complete travel through the system until steady "steady-state" operation is achieved. The model is then run at these steady-state conditions for several days, weeks or even years, depending on the complexity of the model.

25803 (WHC-SA–1813) **Organizational impacts to conduct of operations.** Ames, C.P. Westinghouse Hanford Co., Richland, WA (United States). [1993]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (CONF-930538–1: 4. conduct of operations workshop: the key to

continued success, Tampa, FL (United States), 4-6 May 1993). Order Number DE93014630. Source: OSTI; NTIS; GPO Dep.

The Plutonium Finishing Plant has been operating since its construction in 1949. The facility mission has been to support plutonium production and handling activities. The operating organization was developed to address the various missions and traditionally has been based on task definitions. This division by tasks shared responsibility and loss of accountability. Conduct of Operations deal with structured lines of authority, defined responsibilities at the lowest level, and accountability of personnel to those defined responsibilities. This shared responsibility is counter to the philosophy of Conduct of Operations when large aspects of facility operation and control are not addressed. The Plutonium Finishing Plant Operations organization identified the impacts to Conduct of Operations and reorganized to clearly define responsibilities and to enhance the communication-chain by streamlining the organizational structure. This report details organizational structure at the Plutonium Finishing Plant.

25804 (WHC-SA–1830) **The United States Department of Energy process for performance assessment for disposal of low-level radioactive waste.** Wood, D.E. (Westinghouse Hanford Co., Richland, WA (United States)); Owens, K.W.; Wilhite, E.L.; Duggan, G.J. Westinghouse Hanford Co., Richland, WA (United States). Feb 1993. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (CONF-930906–2: '93 international conference on nuclear waste management and environmental remediation, Prague (Czech Republic), 5-11 Sep 1993). Order Number DE93008179. Source: OSTI; NTIS; INIS; GPO Dep.

The US Department of Energy (DOE) manages disposal of low-level radioactive waste through the requirements of DOE Order 5820.2A on Radioactive Waste Management. The order specifies long-term performance objectives for permanent disposal, requires a performance assessment to determine compliance with those objectives, and establishes a Peer Review Panel to review those assessments for technical quality and completeness. A Performance Assessment Task Team has been established to provide guidance and recommend policy for implementation and interpretation of the requirements to those preparing the assessments. This paper describes the requirements, the Peer Review Panel, the Performance Assessment Task Team, and their activities to date.

25805 (WHC-SA–1837) **Tank waste pretreatment issues, alternatives and strategies for resolution.** Miller, W.C. (Westinghouse Hanford Co., Richland, WA (United States)); Appel, J.; Barton, W.B.; Orme, R.M.; Holton, L.K. Jr. Westinghouse Hanford Co., Richland, WA (United States). Feb 1993. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (CONF-930205–66: Waste management '93, Tucson, AZ (United States), 28 Feb - 4 mar 1993). Order Number DE93014490. Source: OSTI; NTIS; INIS; GPO Dep.

The US Department of Energy (DOE) has established the Tank Waste Remediation System (TWRS) to safely manage and dispose of the Hanford Site tank waste. The overall strategy for disposing of tank waste is evolving and initial recommendations on a course of action are expected in March, 1993. Pretreatment of these wastes may be required for one or both of the following reasons: (1) resolution of tank safety issues, and (2) preparation of low level and high level waste fractions for disposal. Pretreatment is faced with several issues that must be addressed by the deployment strategies that are being formulated. These issues are identified. There is also a discussion of several pretreatment deployment strategies and how these strategies address the issues. Finally, the technology alternatives that are being considered for the pretreatment function are briefly discussed.

25806 (WHC-SA–1846) **Master Safety Analysis Report (SAR) approach for solid waste treatment, storage, and disposal facilities.** Bonner, A.L.; Estrellado, J.P. Jr. Westinghouse Hanford Co., Richland, WA (United States). Jun 1993. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (CONF-9306143–14: Energy Facility Contractors Group safety analysis meeting, Denver, CO (United States), 16-18 Jun 1993). Order Number DE93016476. Source: OSTI; NTIS; INIS; GPO Dep.

In 1989, the Hanford Site took on a new mission of waste remediation and environmental cleanup. The Hanford Site vision is to become the leader in environmental cleanup technology while bringing the site back to its environmental pristine condition. This technology drive to launch the Hanford site as the flagship of environmental restoration has been divided into several mission areas. This paper focuses on the solid waste management (SWM) mission.

25807 (WHC-SA–1866) **Hanford Site radioactive mixed waste thermal treatment initiative.** Place, B.G.; Riddelle, J.G. Westinghouse Hanford Co., Richland, WA (United States). Mar 1993. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (CONF-930572–5: 12. annual international symposium on thermal treatment technologies - incineration conference, Knoxville, TN (United States), 3-7 May 1993). Order Number DE93013005. Source: OSTI; NTIS; INIS; GPO Dep.

This paper is a progress report of current Westinghouse Hanford Company engineering activities related to the implementation of a program for the thermal treatment of the Hanford Site radioactive mixed waste. Topics discussed include a site-specific engineering study, the review of private sector capability in thermal treatment, and thermal treatment of some of the Hanford Site radioactive mixed waste at other US Department of Energy sites.

25808 (WHC-SA–1920) **Developing waste separations technologies in the Underground Storage Tank – Integrated Demonstration Program.** Cruse, J.M. Westinghouse Hanford Co., Richland, WA (United States). Apr 1993. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (CONF-930873–15: 2. international mixed waste symposium, Baltimore, MD (United States), 17-20 Aug 1993). Order Number DE93014164. Source: OSTI; NTIS; INIS; GPO Dep.

The principal objective of the Underground Storage Tank - Integrated Demonstration (UST-ID) Program is the demonstration and continued development of technologies suitable for the remediation of USTs. This paper focuses on the Waste Separations and Pretreatment area of the UST-ID, summarizing the currently funded technology development projects. In this area, several "compact processing units" are being developed to effect near-term demonstration and deployment of promising processes in actual tank environments. The compact processing units design and development approach is summarized. A number of programmatic issues are discussed, including onsite and offsite transportation of potentially contaminated processing systems, containment design criteria, including applicable codes and standards, and operation and maintenance of such systems in a developmental testing environment.

25809 (WHC-SA–1928) **Co-disposal of mixed waste materials.** Phillips, S.J.; Alexander, R.G.; Crane, P.J.; England, J.L.; Kemp, C.J.; Stewart, W.E. Westinghouse Hanford Co., Richland, WA (United States). Aug 1993. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (CONF-930873–20: 2. international mixed waste symposium, Baltimore, MD (United States), 17-20 Aug 1993). Order Number DE93016347. Source: OSTI; NTIS; INIS; GPO Dep.

Co-disposal of process waste streams with hazardous and radioactive materials in landfills results in large, use-efficiencies waste minimization and considerable cost savings. Wasterock, produced from nuclear and chemical process waste streams, is segregated, treated, tested to ensure regulatory compliance, and then is placed in mixed waste landfills, burial trenches, or existing environmental restoration sites. Large geotechnical unit operations are used to pretreat, stabilize, transport, and emplace wasterock into landfill or equivalent subsurface structures. Prototype system components currently are being developed for demonstration of co-disposal.

25810 (WHC-SP–0858-Rev.1) **Maintenance Implementation Plan for B Plant: Revision 1.** Tritt, S.E. Westinghouse Hanford Co., Richland, WA (United States). Apr 1993. 66p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE93014635. Source: OSTI; NTIS; INIS; GPO Dep.

The objective of the Maintenance Implementation Plan (MIP) is to describe how the B Plant will implement the requirements established by US Department of Energy (DOE) Order 4330.4A,

Maintenance Management Program, Chapter II, "Nuclear Facilities" (DOE 1990). The plan provides a blueprint for a disciplined approach to implementation and compliance. Each element of the order is prioritized, categorized, and then placed into one of three phases for implementation.

25811 (WINCO–1122) **ICPP Waste Management Technology Development Program.** Hogg, G.W. (Westinghouse Idaho Nuclear Co., Inc., Idaho Falls, ID (United States)); Olson, A.L.; Knecht, D.A.; Bonkoski, M.J. Westinghouse Idaho Nuclear Co., Inc., Idaho Falls, ID (United States). Jan 1993. 21p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-84ID12435. Order Number DE93009613. Source: OSTI; NTIS; INIS; GPO Dep.

As a result of the decision to curtail reprocessing at the Idaho Chemical Processing Plant (ICPP), a Spent fuel and Waste Management Technology Development plan has been implemented to identify acceptable options for disposing of the (1) sodium-bearing liquid radioactive waste, (2) radioactive calcine, and (3) irradiated spent fuel stored at the Idaho National Engineering Laboratory (INEL). The plan was developed jointly by DOE and WINCO.

25812 (WINCO–11916) **Robotic systems for the high level waste tank farm replacement project at INEL.** Berger, A. (Redzone Robotics, Inc., Pittsburgh, PA (United States)); White, D.; Thompson, B.; Christensen, M. Westinghouse Idaho Nuclear Co., Inc., Idaho Falls, ID (United States). [1993]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-84ID12435. (CONF-930403–52: 5. topical meeting on robotics and remote systems, Knoxville, TN (United States), 26-29 Apr 1993). Order Number DE93015572. Source: OSTI; NTIS; INIS; GPO Dep.

Westinghouse Idaho Nuclear Company (WINCO) is specifying and designing a new high level waste tank farm at the Idaho National Engineering Laboratory (INEL). The farm consists of four underground storage tanks, which replace the existing tanks. The new facility includes provisions for remote operations. One of the planned remote operations is robotic inspection of the tank from the interior and exterior. This paper describes the process used to design the robotic system for the inspection tasks.

25813 (WINCO–11923) **Summary of meeting on disposal of LET&D HEPA filters.** Westinghouse Idaho Nuclear Co., Inc., Idaho Falls, ID (United States). 21 Nov 1991. 130p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-84ID12435. Order Number DE93015571. Source: OSTI; NTIS; INIS; GPO Dep.

This report is a compilation of correspondence between Westinghouse Idaho Nuclear Company and the US EPA over a period of time from 1988 to 1992 (most from 1991-92) regarding waste management compliance with EPA regulations. Typical subjects include: compliance with satellite accumulation requirements; usage of "Sure Shot" containers in place of aerosol cans; notice of upcoming recyclable battery shipments; disposition of batteries; HEPA filter leach sampling and permit impacts; functional and operation requirements for the spent filter handling system; summary of meeting on disposal of LET and D HEPA filters; solvent substitution database report; and mercury vapor light analytical testing.

25814 (WSRC-MS–92-033) **Development of exposure scenarios for CERCLA risk assessments at the Savannah River Site.** Nix, D.W. (Westinghouse Savannah River Co., Aiken, SC (United States)); Immel, J.W.; Phifer, M.A. Westinghouse Savannah River Co., Aiken, SC (United States). [1992]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-920307–92: Waste management '92, Tucson, AZ (United States), 1-5 Mar 1992). Order Number DE93011786. Source: OSTI; NTIS; INIS; GPO Dep.

A CERCLA Baseline Risk Assessment (BRA) is performed to determine if there are any potential risks to human health and the environment from waste unit at SRS. The SRS has numerous waste units to evaluate in the RFMU and CMS/FS programs and, in order to provide a consistent approach, four standard exposure scenarios were developed for exposure assessments to be used in human health risk assessments. The standard exposure scenarios are divided into two temporal categories: (a) Current Land Use in the BRA, and (b) Future Land Use in the RERA. The Current Land Use scenarios consist of the evaluation of human health risk for Industrial Exposure (of a worker not involved in waste unit characterization or remediation), a Trespasser, a hypothetical current On-site Resident, and an Off-site Resident. The Future Land Use scenario considers exposure to an On-site Resident following termination of institutional control in the absence of any remedial action (No Action Alternative), as well as evaluating potential remedial alternatives against the four scenarios from the BRA. A critical facet in the development of a BRA or RERA is the scoping of exposure scenarios that reflect actual conditions at a waste unit, rather than using factors such as EPA Standard Default Exposure Scenarios (OSWER Directive 9285.6-03) that are based on upper-bound exposures that tend to reflect worst case conditions. The use of site-specific information for developing risk assessment exposure scenarios will result in a more realistic estimate of Reasonable Maximum Exposure for SRS waste units.

25815 (WSRC-MS–92-268) **Measurement of cesium and mercury emissions from the vitrification of simulated high level radioactive waste.** Zamecnik, J.R. Westinghouse Savannah River Co., Aiken, SC (United States). [1992]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-930906–1: '93 international conference on nuclear waste management and environmental remediation, Prague (Czech Republic), 5-11 Sep 1993). Order Number DE93005546. Source: OSTI; NTIS; INIS; GPO Dep.

In the Defense Waste Processing Facility at the Savannah River Site, it is desired to measure non-radioactive cesium in the offgas system from the glass melter. From a pilot scale melter system, offgas particulate samples were taken on filter paper media and analyzed by Inductively Coupled Plasma-Mass Spectrometry (ICP-MS). The ICP-MS method proved to be sufficiently sensitive to measure cesium quantities as low as 0.135 μg, with the sensitivity being limited by the background cesium present in the filter paper. This sensitivity allowed determination of cesium decontamination factors for four of the five major components of the offgas system. In addition, total particulate measurements were also made. Measurements of mercury decontamination factors were made on the same equipment; the results indicate that most of the mercury in the offgas system probably exists as elemental mercury and $HgCl_2$, with some HgO and Hg_2Cl_2. The decontamination factors determined for cesium, total particulate, and mercury all compared favorably with the design values.

25816 (WSRC-MS–92-485) **Relationship between borosilicate glass composition, structure, and durability test response (SRS).** Ramsey, W.G. (Westinghouse Savannah River Co., Aiken, SC (United States)); Jantzen, C.M.; Taylor, T.D. Westinghouse Savannah River Co., Aiken, SC (United States). [1992]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-930438–19: 95. annual meeting of the American Ceramic Society, Cincinnati, OH (United States), 18-22 Apr 1993). Order Number DE93013578. Source: OSTI; NTIS; GPO Dep.

The chemical durability of 30 glasses from the $Na_2O \cdot B_2O_3 \cdot SiO_2 \cdot Al_2O_3 \cdot Fe_2O_3 \cdot CaO$ system was examined. Two standard leach tests, MCC-1P and PCT, were performed in unbuffered, deionized water. PCT tests were performed for durations up to twenty-four weeks to obtain glass dissolution rate data. Short-term MCC-1P test leachate solutions are determined by the glass composition. Long-term glass dissolution rates, however, are dependent on glass structure in addition to glass composition. The applicability of the free energy of hydration and other dissolution and durability models to this system is discussed.

25817 (WSRC-MS–92-503-Rev.1) **Conditions for precipitation of copper phases in DWPF waste glass: Revision 1.** Schumacher, R.F.; Ramsey, W.G. Westinghouse Savannah River Co., Aiken, SC (United States). [1993]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-930438–1-Rev.1: 95. annual meeting of the American Ceramic Society, Cincinnati, OH (United States), 18-22 Apr 1993). Order Number DE93012799. Source: OSTI; NTIS; INIS; GPO Dep.

The Defense Waste Processing Facility precipitate hydrolysis process requires the use of copper formate as a catalyst. The expected absorbed radiation doses to the salt precipitate require higher levels of copper formate which increase the potential for the

precipitation of metallic copper containing phases in the DWPF Melter. The conditions required to avoid the precipitation of copper phases are described in this report.

25818 (WSRC-MS–93-002-Rev.1) **Waste acceptance product specifications for vitrified high-level waste forms: Revision 1.** Applewhite-Ramsey, A.; Sproull, J.F. Westinghouse Savannah River Co., Aiken, SC (United States). [1993]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-930438–Rev.1: 95. annual meeting of the American Ceramic Society, Cincinnati, OH (United States), 18-22 Apr 1993). Order Number DE93014758. Source: OSTI; NTIS; INIS; GPO Dep.

The Nuclear Waste Policy Act of 1982 mandated that all high-level waste (HLW) be sent to a federal geologic repository for permanent disposal. DOE published the Environmental Assessment in 1982 which identified borosilicate glass as the chosen HLW form.[1] In 1985 the Department of Energy instituted a Waste Acceptance Process to assure that DWPF glass waste forms would be acceptable to such a repository. This assurance was important since production of waste forms will precede repository construction and licensing. As part of this Waste Acceptance Process, the DOE Office of Civilian Radioactive Waste Management (RW) formed the Waste Acceptance Committee (WAC). The WAC included representatives from the candidate repository sites, the waste producing sites and DOE. The WAC was responsible for developing the Waste Acceptance Preliminary Specifications (WAPS) which defined the requirements the waste forms must meet to be compatible with the candidate repository geologies.

25819 (WSRC-MS–93-056) **An investigation of Inventory Differences.** Harvel, C. Westinghouse Savannah River Co., Aiken, SC (United States). [1993]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-930749–6: 34. annual meeting of the Institute of Nuclear Materials Management, Scottsdale, AZ (United States), 18-21 Jul 1993). Order Number DE93017285. Source: OSTI; NTIS; INIS; GPO Dep.

The derivation of applicable Limits of Error for Inventory Differences (LEIDs) has been a long-term challenge for some material storage tanks at the Savannah River Site. Several investigations have been unsuccessful in producing usable estimates of the LEIDs. An investigation conducted in November of 1991 revealed some significant inventory characteristics. The corrective action involved the implementation of a multi-case LEID based on historical information and a correction in the use of the tank calibration charts for two storage tanks.

25820 (WSRC-MS–93-184) **UV disinfection pilot plant study at the Savannah River Site.** Huffines, R.L.; Beavers, B.A. Westinghouse Savannah River Co., Aiken, SC (United States). [1993]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-9303166–1: 1993 South Carolina environmental conference, Hilton Head, SC (United States), 30 Mar 1993). Order Number DE93012800. Source: OSTI; NTIS; GPO Dep.

An ultraviolet light disinfection system pilot plant was operated at the Savannah River Site Central Shops sanitary wastewater treatment package plant July 14, 1992 through August 13, 1992. The purpose was to determine the effectiveness of ultraviolet light disinfection on the effluent from the small package-type wastewater treatment plants currently used on-site. This pilot plant consisted of a rack of UV lights suspended in a stainless steel channel through which a sidestream of effluent from the treatment plant clarifier was pumped. Fecal coliform analyses were performed on the influent to and effluent from the pilot unit to verify the disinfection process. UV disinfection was highly effective in reducing fecal coliform colonies within NPDES permit limitations even under process upset conditions. The average fecal coliform reduction exceeded 99.7% using ultraviolet light disinfection under normal operating conditions at the package treatment plants.

25821 (WSRC-MS–93-202) **Treatment and disposal of a mixed F006 plating line sludge at the Savannah River Site.** Pickett, J.B.; Musall, J.C.; Martin, H.L. Westinghouse Savannah River Co., Aiken, SC (United States). [1993]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-930873–12: 2. international mixed waste symposium, Baltimore, MD (United States), 17-20 Aug 1993). Order Number DE93013827. Source: OSTI; NTIS; INIS; GPO Dep.

The Westinghouse Savannah River Company (WSRC), as the operating contractor for the Department of Energy (DOE) at the Savannah River Site (SRS) is implementing a program to treat and stabilize approximately 750,000 gallons of an F006 mixed (radioactive/hazardous) plating line wastewater sludge. The uranium contaminated sludge resulted from nickel plating of depleted uranium targets, which were subsequently irradiated to produce plutonium for the weapons program. With the end of the "cold war," no virgin plutonium weapons production is forecast, and only the currant SRS inventory of stored mixed plating line waste must be treated and disposed. A Life Cycle Cost analysis was used by WSRC to determine that the most cost effective approach was to treat the waste by a hazardous waste management sub-contractor, in a one time campaign. The analysis indicated that ~$40 million could be saved by this approach, vs. the original plan to construct a permanent SRS treatment facility. The sub-contractor will mobilize treatment equipment will be disposed to on-site SRS disposal vaults. This new approach also required a re-negotiation of a federal facility compliance agreement between the DOE and the Environmental Protection Agency.

25822 (WSRC-MS–93-215) **Pilot scale vitrification studies on hazardous and mixed wastes.** Bennert, D.M. (Clemson Univ., SC (United States). Dept. of Environmental Systems Engineering); Overcamp, T.J.; Compton, K.L.; Sargent, T.N. Jr.; Resce, J.L.; Bickford, D.F.; Jantzen, C.M. Westinghouse Savannah River Co., Aiken, SC (United States). [1993]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-930438–13: 95. annual meeting of the American Ceramic Society, Cincinnati, OH (United States), 18-22 Apr 1993). Order Number DE93012798. Source: OSTI; NTIS; INIS; GPO Dep.

Over the past 30 years, the Department of Energy has committed extensive resources to the development of technologies suitable for the stabilization of high level radioactive waste. The objective of this work is to produce a vitreous wasteform capable of retaining the radioactive fractions in a leach resistant form. In an effort to further the development of technologies based within the DOE Complex, the DOE is making efforts to promote technical transfer initiatives that will bring these technologies to the private sector. To this end, the Department of Energy through the Savannah River Site is working with Clemson University's Environmental Systems Engineering Department to establish a laboratory dedicated to vitrification research. The laboratory is part of a cooperative effort between Westinghouse Savannah River Company, Clemson University, and their industrial partners EnVitCo, Inc., and Stir Melter, Inc.

25823 (WSRC-MS–93-222) **Canonical correlation of waste glass compositions and durability, including pH.** Oeksoy, D. (Alfred Univ., NY (United States)); Pye, L.D.; Bickford, D.F.; Ramsey, W.G. Westinghouse Savannah River Co., Aiken, SC (United States). [1993]. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-930438–8: 95. annual meeting of the American Ceramic Society, Cincinnati, OH (United States), 18-22 Apr 1993). Order Number DE93012754. Source: OSTI; NTIS; INIS; GPO Dep.

Control of waste glass durability is a major concern in the immobilization of radioactive and mixed wastes. Leaching rate in standardized laboratory tests is being used as a demonstration of consistency of the response of waste glasses in the final disposal environment. The leaching of silicate and borosilicate glasses containing alkali or alkaline earth elements is known to be autocatalytic, in that the initial ion exchange of alkali in the glass for hydrogen ions in water results in the formation of OH and increases the pH of the leachate. The increased pH then increases the rate of silicate network attack, accelerating the leaching effect. In well formulated glasses this effect reaches a thermodynamic equilibrium when leachate saturation of a critical species, such as silica, or a dynamic equilibrium is reached when the pH shift caused by incremental leaching has negligible effect on pH. This report analyzes results of a seven leach test on waste glasses.

25824 (WSRC-RP–92-252) **Supercritical water oxidation technology for DWPF.** Carter, J.T.; Gentilucci, J.A. Westinghouse Savannah River Co., Aiken, SC (United States). 7 Feb 1992. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93015382. Source: OSTI; NTIS; GPO Dep.

At the request of Mr. H.L. Brandt and others in the Savannah River Field Office High Level Waste Division office, DWPF, and SRL personnel have reviewed two potential applications for supercritical water oxidation technology in DWPF. The first application would replace the current hydrolysis process by destroying the organic fractions of the precipitated cesium /potassium tetraphenylborate slurry. The second application pertains to liquid benzene destruction. After a thorough evaluation the first application is not recommended. The second is ready to be tested if needed.

25825 (WSRC-RP–92-568-Rev.1) **DWPF saltstone study: Effects of thermal history on leach index and physical integrity: Part 2, Final report: Revision 1.** Orebaugh, E.G. Westinghouse Savannah River Co., Aiken, SC (United States). 18 Nov 1992. 37p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93015831. Source: OSTI; NTIS; INIS; GPO Dep.

This report summarizes the observations made during the curing and testing of DWPF simulated saltstones which have been cured under isothermal conditions in sealed glass envelopes at temperatures from room temperature to 95°C. This study was performed to evaluate the effect of curing at and around temperatures representing conditions created within large pours of grout. There appears to be no difference in the leaching resistance of samples cured at the same temperature for varying times to 1 year. Curing at higher temperatures decreases the effective diffusivity of this waste formulation. These results are encouraging in that leaching resistance for samples near the expected maximum vault temperature (55°C) show effective diffusion coefficients ($D_{effective}$ $\sim 10^{-8}$ cm^2/sec) that agree with previous work and values that are believed to adequately protect the groundwater. The isothermal conditions of these tests simulate the nearly adiabatic conditions existing near the centerline of the monolith. The elevated temperatures due to hydration heat decrease over long times. This has been simulated by a series (1X) of staged isothermal cures. Since modeling indicated it would take nearly two years for emplaced grout to cool to near ambient temperatures, accelerated (2X) cooling curves were also tested. Specimens cured under these staged-isothermal conditions appear to be no different from specimens cured under isothermal conditions for the same time at the maximum temperature. The unexpected generation of nitrous oxide within saltstone creates internal stresses which cause fracturing when exposed to leaching conditions. Such fracturing is not considered significant for saltstone emplaced in engineered vaults for disposal.

25826 (WSRC-RP–92-1093) **Ion exchange technology assessment report.** Duhn, E.F. Westinghouse Savannah River Co., Aiken, SC (United States). 1992. 98p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93016126. Source: OSTI; NTIS; INIS; GPO Dep.

In the execution of its charter, the SRS Ion Exchange Technology Assessment Team has determined that ion exchange (IX) technology has evolved to the point where it should now be considered as a viable alternative to the SRS reference ITP/LW/PH process. The ion exchange media available today offer the ability to design ion exchange processing systems tailored to the unique physical and chemical properties of SRS soluble HLW's. The technical assessment of IX technology and its applicability to the processing of SRS soluble HLW has demonstrated that IX is unquestionably a viable technology. A task team was chartered to evaluate the technology of ion exchange and its potential for replacing the present In-Tank Precipitation and proposed Late Wash processes to remove Cs, Sr, and Pu from soluble salt solutions at the Savannah River Site. This report documents the ion exchange technology assessment and conclusions of the task team.

25827 (WSRC-RP–92-1212) **Ammonium generation during SRAT cycle.** Hsu, C.W. Westinghouse Savannah River Co., Aiken, SC (United States). 13 Oct 1992. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93015383. Source: OSTI; NTIS; INIS; GPO Dep.

During the IDMS noble-metal demonstration runs ammonium nitrate deposition was found in the vessel vent system of the feed preparation area. In the bench-scale experiments of studying the hydrogen generation during the sludge treatment cycle, ammonium ion production was also monitored. It was found that: During a simulation of the DWPF Cold Chemical Runs SRAT cycle no detectable amount of ammonium ions was generated when treating a non-noble-metal containing sludge simulant according to the nitric acid flowsheet. Ammonium ions were generated during the SRAT-SME cycle when treating the noble-metal containing sludge with either formic acid or nitric acid/late-washing PHA. This is due to the reaction between formic acid and nitrate catalyzed by the noble metals in the sludge simulant. Ammonium ion production closely followed the hydrogen evolution from the catalytic decomposition of formic acid. This report summarizes the results of the production of ammonia during the SRAT cycle.

25828 (WSRC-RP–92-1312) **Radiolytic hydrogen production from process vessels in HB line - production rates compared to evolution rates and discussion of LASL reviews.** Bibler, N.E. Westinghouse Savannah River Co., Aiken, SC (United States). 12 Nov 1992. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93014739. Source: OSTI; NTIS; GPO Dep.

Hydrogen production from radiolysis of aqueous solutions can create a safety hazard since hydrogen is flammable. At times this production can be significant, especially in HB line where nitric acid solutions containing high concentrations of Pu-238, an intense alpha emitter, are processed. The hydrogen production rates from these solutions are necessary for safety analyses of these process systems. The methods and conclusions of hydrogen production rate tests are provided in this report.

25829 (WSRC-RP–92-1392) **Travel to Tokai Vitrification Facility to discuss the melter and process operational experiences with noble metals: Foreign trip report, November 18–19, 1992.** Gutmann, T.S. (USDOE Savannah River Operations Office, Aiken, SC (United States)); Carter, J.T.; Hutson, N.D.; Palmer, R.A.; Harty, W.M.; Lamar, D.A. Westinghouse Savannah River Co., Aiken, SC (United States). 14 Dec 1992. 238p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93011431. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report documents the technical exchange meeting held between the United States Department of Energy (DOE) and the Power Reactor and Nuclear Fuel Development Corporation (PNC) of Japan. The meeting was held at PNC's Tokai Works located in Tokai-mura, about 65 miles northeast of Tokyo. This meeting was the fifth in the series of technical exchanges held to date under the bilateral agreement between DOE and PNC on vitrification technology.

25830 (WSRC-RP–93-469) **Savannah River Site TIER TWO report 1992: Emergency and Hazardous Chemical Inventory report.** Still, G.O. Westinghouse Savannah River Co., Aiken, SC (United States). Mar 1993. 150p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93016134. Source: OSTI; NTIS; INIS; GPO Dep.

This report is a compilation of data on emergency and hazardous chemicals stored at the Savannah River Site. The report lists quantities of materials, general types of storage containment, types of storage conditions (pressure and temperature), and other information of relevance for particular materials.

25831 (WSRC-TR–91-566) **Carbon-14 removal for disposal of reactor deionizer resins.** Carlton, W.H.; Baumann, E.W. Westinghouse Savannah River Co., Aiken, SC (United States). 31 Oct 1991. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93014747. Source: OSTI; NTIS; INIS; GPO Dep.

Disposal of depleted ion exchange resins from the primary system of the Savannah River Site (SRS) reactors is complicated by the presence of Carbon-14. Because Carbon-14 has a long half-life (5,730 years) and high mobility in soils, burial of the resins is no

longer a viable option. Consequently some 35 spent reactor deionizers have accumulated that are to be stored aboveground in H-Area for an indefinite period. Spent deionizers containing Carbon-14 will continue to accumulate with operation of the present production reactors and would also accumulate from the proposed heavy water new production reactor. Removal of the Carbon-14 from the resins would reduce the volume of Carbon-14 bearing waste and enable the resins to be disposed of as low-level waste. Studies at SRS have indicated that the Carbon-14 from reactor primary coolant is mostly retained by the resins as the bicarbonate anion. Thus Carbon-14 removal might be accomplished by an acidification operation with trapping of the carbon dioxide released, for separate disposal. Conversion of the bicarbonate from the resin to barium carbonate, for example, would reduce the volume of waste more than a hundredfold. Displacement and recovery of Carbon-14 dioxide from reactor coolant deionizers by acid treatment has been reported by the Canadians. This memorandum recommends that a process be developed for Carbon-14 dioxide removal from SRS spent reactor deionizer resins, drawing on the Canadian experience.

25832 (WSRC-TR–92-421) **Revisions to the hydrogen gas generation computer model.** Jerrell, J.W. Westinghouse Savannah River Co., Aiken, SC (United States). 31 Aug 1992. 22p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93012136. Source: OSTI; NTIS; GPO Dep.

Waste Management Technology has requested SRTC to maintain and extend a previously developed computer model, TRUGAS, which calculates hydrogen gas concentrations within the transuranic (TRU) waste drums. TRUGAS was written by Frank G. Smith using the BASIC language and is described in the report A Computer Model of gas Generation and Transport within TRU Waste Drums (DP- 1754). The computer model has been partially validated by yielding results similar to experimental data collected at SRL and LANL over a wide range of conditions. The model was created to provide the capability of predicting conditions that could potentially lead to the formation of flammable gas concentrations within drums, and to assess proposed drum venting methods. The model has served as a tool in determining how gas concentrations are affected by parameters such as filter vent sizes, waste composition, gas generation values, the number and types of enclosures, water instrusion into the drum, and curie loading. The success of the TRUGAS model has prompted an interest in the 'program's maintenance and enhancement. Experimental data continues to be collected at various sites on such parameters as permeability values, packaging arrangements, filter designs, and waste contents. Information provided by this data is used to improve the accuracy of the model's predictions. Also, several modifications to the model have been made to enlarge the scope of problems which can be analyzed. For instance, the model has been used to calculate hydrogen concentrations inside steel cabinets containing retired glove boxes (WSRC-RP-89-762). The revised TRUGAS computer model, H2GAS, is described in this report. This report summarizes all modifications made to the TRUGAS computer model and provides documentation useful for making future updates to H2GAS.

25833 (WSRC-TR–93-029) **Monosodium titanate particle characterization.** Chandler, G.T.; Hobbs, D.T. Westinghouse Savannah River Co., Aiken, SC (United States). 12 Jan 1993. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93015890. Source: OSTI; NTIS; INIS; GPO Dep.

A characterization study was performed on monosodium titanate (MST) particles to determine the effect of high shear forces expected from the In-Tank Precipitation (ITP) process pumps on the particle size distribution. The particles were characterized using particle size analysis and scanning electron microscopy (SEM). No significant changes in particle size distributions were observed between as-received MST and after 2–4 hours of shearing. Both as-received and sheared MST particles contained a large percentage of porosity with pore sizes on the order of 500 to 2,000 Angstroms. Because of the large percentage of porosity, the overall surface area of the MST is dominated by the internal surfaces. The uranium and plutonium species present in the waste solution will have access to both interior and exterior surfaces. Therefore, uranium and plutonium loading should not be a strong function of MST particle size.

25834 (WSRC-TR–93-090) **Electrochemical processing of nitrate waste solutions: Phase 2, Final report.** Genders, D. (Electrosynthesis Co., Inc., Cheektowaga, NY (US)); Weinberg, N.; Hartsough, D. Westinghouse Savannah River Co., Aiken, SC (United States); Electrosynthesis Co., Inc., Cheektowaga, NY (United States). 7 Oct 1992. 202p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93016166. Source: OSTI; NTIS; INIS; GPO Dep.

The second phase of research performed at The Electrosynthesis Co., Inc. has demonstrated the successful removal of nitrite and nitrate from a synthetic effluent stream via a direct electrochemical reduction at a cathode. It was shown that direct reduction occurs at good current efficiencies in 1,000 hour studies. The membrane separation process is not readily achievable for the removal of nitrites and nitrates due to poor current efficiencies and membrane stability problems. A direct reduction process was studied at various cathode materials in a flow cell using the complete synthetic mix. Lead was found to be the cathode material of choice, displaying good current efficiencies and stability in short and long term tests under conditions of high temperature and high current density. Several anode materials were studied in both undivided and divided cell configurations. A divided cell configuration was preferable because it would prevent re-oxidation of nitrite by the anode. The technical objective of eliminating electrode fouling and solids formation was achieved although anode materials which had demonstrated good stability in short term divided cell tests corroded in 1,000 hour experiments. The cause for corrosion is thought to be F^- ions from the synthetic mix migrating across the cation exchange membrane and forming HF in the acid anolyte. Other possibilities for anode materials were explored. A membrane separation process was investigated which employs an anion and cation exchange membrane to remove nitrite and nitrate, recovering caustic and nitric acid. Present research has shown poor current efficiencies for nitrite and nitrate transport across the anion exchange membrane due to co-migration of hydroxide anions. Precipitates form within the anion exchange membranes which would eventually result in the failure of the membranes. Electrochemical processing offers a highly promising and viable method for the treatment of nitrate waste solutions.

25835 (WSRC-TR–93-233) **DWPF recycle stream corrosion tests.** Zapp, P.E. Westinghouse Savannah River Co., Aiken, SC (United States). 21 Apr 1993. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93016151. Source: OSTI; NTIS; GPO Dep.

Coupon immersion tests were performed on ASTM A537 Class 1 carbon steel in simulated DWPF recycle solutions at 90 $\pm$ 2°C, as part of the continuing effort to investigate the formation of shock-sensitive deposits. Coupons were partially immersed for four months in solutions of the same composition used previously at SRTC and at the DuPont Engineering Test Center (a salt solution containing 0.5 M hydroxide and 0.043 M nitrite). Shock-sensitive deposits were not seen on the coupons from this test. There was considerable general corrosion above the water line due to condensate and distilled water contact of the steel. New immersion tests are being planned for completion by September, 1993. The new test solution will reflect the recycle stream chemistry changes brought about by planned ammonia scrubbing in the DWPF.

25836 (YJT–92-24) **SIMFUEL dissolution studies in granitic groundwater leaching experiments at VTT.** Ollila, K. (Technical Research Centre of Finland, Espoo (Finland). Reactor Lab.). Nuclear Waste Commission of Finnish Power Companies, Helsinki (Finland). Dec 1992. [41p.] Order Number DE93629788. Source: OSTI; NTIS; INIS.

The dissolution behaviour of an irradiated analogue of spent nuclear fuel, SIMFUEL, was studied in synthetic granitic groundwater. The release of uranium and the minor components was monitored during static (bach) leaching experiments in oxic and anoxic (N_2) atmosphere at 25 deg C. Molybdenum, ruthenium, barium and zirconium showed a trend to congruent dissolution behaviour with UO_2 matrix towards the end of the experimental time (540 days)

under anoxic conditions. Under oxic conditions, molybdenum and strontium had higher release rates relative to the matrix (the exp. time of 220 days). The presence of particulate material in the leachates in anoxic atmosphere was shown by SEM/EDX and XRD analyses. The material retained on membrane after filtration consisted of Ca-rich and U-rich particles in addition to finely divided material. Calcite ($CaCO_3$) and uranium oxide were identified. (orig.).

25837 (YJT–92-25) **Sorption of uranium on rocks in anaerobic groundwater.** Hakanen, M. (Helsinki Univ. (Finland). Dept. of Radiochemistry); Lindberg, A. Nuclear Waste Commission of Finnish Power Companies, Helsinki (Finland). Dec 1992. [29p.] Order Number DE93629789. Source: OSTI; NTIS; INIS.

Spent nuclear fuel contains substantial amounts of long lived isotopes of actinoide elements, the most abundant of which is the oxide from uranium in the fuel matrix. The behaviour of uranium, also present in small concentrations in natural rocks and waters, is redox sensitive. The concentration controlling mechanisms in groundwaters of uranium are not well-known. In this work a series of laboratory experiments was made to study the redox and sorption behaviour of uranium under anaerobic conditions. The experiments indicated that a part of uranium(VI) was reduced to uranium(IV). The sorbed uranium was of mixed oxidation states. The redox potential of water was not an appropriate indicator of the U(IV)/U(VI) ratio. Spiking of the water with the U(IV) was followed by very strong sorption. The derived lower limit (conservative) and the realistic mass distribution ratios (R_d) for U(IV) are 0.7 m^3/kg and 3.5 m^3/kg. (orig.).

25838 (YJT–92-26) **Hydraulic fracturing rock stress measurement at Haestholmen, Finland.** Ljunggren, C. (Renco AB, Luleaa (Sweden)); Klasson, H. Nuclear Waste Commission of Finnish Power Companies, Helsinki (Finland). Dec 1992. [59p.] Order Number DE93630655. Source: OSTI; NTIS; INIS.

This report presents hydraulic fracturing measurements in two boreholes located on the Haestholmen island near Loviisa, Finland. The aim of the measurements was to provide stress data, forming input for the design of an underground facility for disposal of low- and medium-level waste as well as future plant decommissioning radioactive waste from the IVO reactor units situated on Haestholmen. The theoretical background to the hydrofracturing method is summarized, as is the equipment and experimental procedures used in the present case. All results obtained are presented and critically discussed. The final stress parameters presented are magnitudes and directions of the maximum and minimum horizontal stresses. Testing was successfully completed according to schedule in both boreholes.(orig.).

25839 (YJT–92-31) **Final disposal of spent fuel in the Finnish bedrock: Technical plans and safety assessment.** Nuclear Waste Commission of Finnish Power Companies, Helsinki (Finland). Dec 1992. [142p.] (In Finnish). Order Number DE93629790. Source: OSTI; NTIS; INIS.

Teollisuuden Voima Oy (TVO) is preparing for the final disposal of spent nuclear fuel from the Olkiluoto nuclear power plant (TVO-I and TVO-II reactors). According to present estimates, a total of 1840 tU of spent fuel will be accumulated during the 40-year lifetime of the power plant. An interim storage facility for spent fuel (TVO-KPA Store) has operated at Olkiluoto since 1987. The spent fuel will be held in storage for several decades before it is shipped to the repository site. Both train and road transportation are possible. The spent fuel will be encapsulated in composite copper and steel canisters (ACP Canister) in a facility that will be build above the ground on the site where the repository is located. The repository will be constructed at the depth of several hundreds of meters in the bedrock. In 1987 five areas were selected for preliminary site investigations. The safety analysis (TVO-92) that was carried out shows that the proposed safety criteria would be met at each of the candidate sites. In future expected conditions there would never be significant releases of radioactive substances to the biosphere. The site investigations will be continued in the period 1993 to 2000. In parallel, a R and D programme will be devoted to the safety and technology of final disposal. The site for final disposal will be selected in the year 2000 with the aim of having the capability to start the disposal operations in 2020.

25840 (YJT–92-32) **Final disposal of spent nuclear fuel in the Finnish bedrock: Preliminary site investigations.** Nuclear Waste Commission of Finnish Power Companies, Helsinki (Finland). Dec 1992. [359p.] (In Finnish). Order Number DE93629791. Source: OSTI; NTIS; INIS.

Teollisuuden Voima Oy (TVO) studies Finnish bedrock for the final disposal of the spent nuclear fuel from the Olkiluoto nuclear power plant. The study is in accordance with the decision in principle by Finnish government in 1983. The report is the summary of the preliminary site investigations carried out during the years 1987-1992. On the basis of these investigations a few areas will be selected for detailed site investigation. The characterization comprises five areas selected from the shortlist of potential candidate areas resulted in the earlier study during 1983-1985. Areas are located in different parts of Finland and they represent the main formations of the Finnish bedrock. Romuvaara area in Kuhmo and Veitsivaara area in Hyrynsalmi represent the Archean basement. Kivetty area in Konginkangas consists of mainly younger granitic rocks. Syyry in Sievi is located in transition area of Svecofennidic rocks and granitic rocks. Olkiluoto in Eurajoki represents migmatites in southern Finland. For the field investigations area-specific programs were planned and executed. The field investigations have comprised airborne survey by helicopter, geophysical surveys, geological mappings and samplings, deep and shallow core drillings, geophysical and hydrological borehole measurements and groundwater samplings.

25841 (YJT–93-03) **Long-term durability experiments with concrete-based waste packages in simulated repository conditions.** Ipatti, A. (Imatran Voima Oy, Vantaa (Finland)). Nuclear Waste Commission of Finnish Power Companies, Helsinki (Finland). Mar 1993. [71p.] Order Number DE93631592. Source: OSTI; NTIS; INIS.

Two extensive experiments on long-term durability of waste packages in simulated repository conditions are described. The first one is a 'half-scale experiment' comprising radioactive waste product and half-scale concrete containers in site specific groundwater conditions. The second one is 'full-scale experiment' including simulated inactive waste product and full-scale concrete container stored in slowly flowing fresh water. The scope of the experiments is to demonstrate long-term behaviour of the designed waste packages in contact with moderately concrete aggressive groundwater, and to evaluate the possible interactions between the waste product, concrete container and ground water. As the waste packages are made of high-quality concrete, provisions have been made to continue the experiments for several years.

25842 (YJT–93-04) **The dissolution of unirradiated UO_2 fuel pellets under simulated disposal conditions.** Ollila, K. (Technical Research Centre of Finland, Espoo (Finland). Reactor Lab.); Leino-Forsman, H. Nuclear Waste Commission of Finnish Power Companies, Helsinki (Finland). Mar 1993. [45p.] Order Number DE93631593. Source: OSTI; NTIS; INIS.

The dissolution behaviour of unirradiated UO_2 pellets was studied as a function of water composition under oxidizing and reducing conditions at 25 deg C. The waters included deionized water as the reference water, sodium bicarbonate solutions with varying bicarbonate content, and two different synthetic groundwaters. The release of uranium was measured during static batch dissolution experiments of long duration (3-4 years).

25843 (YJT–93-05) **Long term corrosion tests of OFHC-coppers in simulated repository conditions: Final report.** Aaltonen, P. (Technical Research Centre of Finland, Espoo (Finland). Metals Lab.); Varis, P. Nuclear Waste Commission of Finnish Power Companies, Helsinki (Finland). Mar 1993. [36p.] Order Number DE93631594. Source: OSTI; NTIS; INIS.

This research program 'long term corrosion tests of OFHC-coppers in simulated repository conditions' was planned to provide an experimental evaluation with respect to the theoretical calculations and forecasts made for the corrosion behaviour of OFHC-coppers in bentonite ground water environments at temperatures between 20-80 deg C. The aim of this study in the first place was to evaluate the effects of ground water composition, bentonite and temperature on the equilibrium and possible corrosion reactions between OFHC coppers and the simulated repository

environment. The tests were started in 1987 and this final report includes the results obtained after 72 months exposure time. (orig.).

25844 (YJT–93-06) **Application of the continuously-yielding joint model for studying disposal of high-level nuclear waste in crystalline rock.** Hakala, M. (Saanio and Riekkola Consulting Engineers, Helsinki (Finland)); Johansson, E.; Simonen, A.; Loring, L. Nuclear Waste Commission of Finnish Power Companies, Helsinki (Finland). Apr 1993. [68p.] Order Number DE93630656. Source: OSTI; NTIS; INIS.

The non-linear Continuously-Yielding (CY) joint model and its use in numerical analyses of a nuclear waste repository are studied in the report. On major advantage of using CY-model is that laboratory test results, if available, can directly be used in analyses thus reducing uncertainties about joint input parameters. The new testing machine MTS-815 of Helsinki University of Technology was used to determine the joint behaviour of some granitic joints from the depth of 400-600 m below the ground surface. The procedure for triaxial joint tests was refined during this work. Two programs called NormFit and SherFit were developed and tested to determine the best fit parameter values for CY-model from laboratory test results.

0530 Environmental Aspects

Refer also to citation(s) 25686, 25696, 25699, 25784, 25862, 25886, 26270, 27358, 27359, 27360, 27361, 27362, 27363, 27378, 27438, 27472, 27473, 27487, 28152

25845 (INIS-mf–12758, pp. 528-533) **Analysis of accidents at the LPR (Radiochemical Processes Laboratory).** Kaufmann, F. (Techint SA, Buenos Aires (Argentina)); Boutet, L.I. Asociacion Argentina de Tecnologia Nuclear, Buenos Aires (Argentina). 1987. [735p.] (In Spanish). (CONF-8711355–: 15. scientific meeting and 4th Latin American meeting and 1st sessions on nuclear power plants, San Carlos de Bariloche (Argentina), 2-6 Nov 1987). In *Proceedings of the fifteenth scientific meeting; fourth Latin American meeting; first sessions on nuclear power plants.* Order Number DE91003052. Source: OSTI; NTIS (US Sales Only); INIS.

Accidents are defined as not planned events that may result in the emission of significative quantities of radioactive materials to the environment. The pilot plant has been specifically designed to prevent this type of accidents but there still exists the possibility that one or more accidents can be produced during the plant life. In a first phase, the emission of radionuclides to the environment were evaluated for 13 credible accidents. In a second phase, by means of the calculation program SEDA, specially adapted to this purpose, the critical doses of critical group were calculated for each accident. Due to the small capacity of the pilot plant and the long cooling period of treated fuel, it is concluded that the radiological consequences for the external environment are of very small magnitude. In this way, without need of developing complex fault- or event-trees, it is shown that any of the accidents falls into the non acceptable zone of Farmer diagram. (Author).

25846 (OEFZS–4637) **Qualitative comparison of the so-called biotransfer model.** Rejlek, G. (Hauptabteilung Entsorgungstechnik, Bereich Umwelt- und Verfahrenstechnik, Forschungszentrum Seibersdorf, Seibersdorf (Austria)). Oesterreichisches Forschungszentrum Seibersdorf GmbH (Austria). Jun 1992. [19p.] (In German). Order Number DE93628044. Source: OSTI; NTIS (US Sales Only); INIS.

As a part of the project 'Final Deposition of Low- and Medium-active Wastes from Hospitals, University Institutes and Industry' a need arose for a biotransfer model to be used with a deterministic safety analysis. A literature study should decide if an existing model could be adapted to the requirements of the 'final dump project' or it is necessary and meaningful to develop a novel, improved model. Because the second variant turned out true the requirements for the improved model are written down.

25847 (OEFZS–4638) **Transbios - a unified model for assessment of the effect of noxious materials in ground water to the biosphere. Compilation of the model.** Rejlek, G. (Hauptabteilung Entsorgungstechnik, Bereich Umwelt- und Verfahrenstechnik, Forschungszentrum Seibersdorf, Seibersdorf (Austria)). Oesterreichisches Forschungszentrum Seibersdorf GmbH (Austria). Jun 1992. [113p.] (In German). Order Number DE93628045. Source: OSTI; NTIS (US Sales Only); INIS.

This model of radionuclide propagation in the biosphere is part of the project 'Final Deposition of Low- and Medium- active Wastes from Hospitals, University Institutes and Industry'. The six parts are: a flow-and transport model in ground water, an evaporation-transpiration model, a transfer model soil-to-plant, a water cycle- and a food chain model. Solutions are designed and peculiarities of the program are outlined. Finally the individual parts are integrated into the overall model.

25848 (WINCO–11906) **NO_x Abatement Pilot Plant 90-day test results report.** McCray, J.A. (EG and G Idaho, Inc., Idaho Falls, ID (United States)); Boardman, R.D. Westinghouse Idaho Nuclear Co., Inc., Idaho Falls, ID (United States); EG and G Idaho, Inc., Idaho Falls, ID (United States). 30 Aug 1991. 83p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-84ID12435. Order Number DE93014874. Source: OSTI; NTIS; INIS; GPO Dep.

High-level radioactive liquid wastes produced during nuclear fuel reprocessing at the Idaho Chemical Processing Plant are calcined in the New Waste Calcining Facility (NWCF) to provide both volume reduction and a more stable waste form. Because a large component of the HLW is nitric acid, high levels of oxides of nitrogen (NO_x) are produced in the process and discharged to the environment via the calciner off-gas. The NO_x abatement program is required by the new Fuel Processing Restoration (FPR) project permit to construct to reduce NO_x emissions from the NWCF. Extensive research and development has indicated that the selective catalytic reduction (SCR) process is the most promising technology for treating the NWCF off-gas. Pilot plant tests were performed to determine the compatibility of the SCR process with actual NWCF off-gas. Test results indicate that the SCR process is a viable method for abating the NO_x from the NWCF off-gas. Reduction efficiencies over 95% can be obtained, with minimal amounts of ammonia slip, provided favorable operating conditions exist. Two reactors operated with series flow will provide optimum reduction capabilities. Typical operation should be performed with a first reactor stage gas space velocity of 20,000 hr^{-1} and an inlet temperature of 320°C. The first stage exhaust NO_x concentration will then dictate the parameter settings for the second stage. Operation should always strive for a peak reactor temperature of 520°C in both reactors, with minimal NH_3 slip from the second reactor. Frequent fluctuations in the NWCF off-gas NO_x concentration will require a full-scale reduction facility that is versatile and quick-responding. Sudden changes in NWCF off-gas NO_x concentrations will require quick detection and immediate response to avoid reactor bed over-heating and/or excessive ammonia slip.

0540 Health and Safety

Refer also to citation(s) 25657, 25659, 25664, 25673, 25675, 25681, 25695, 25723, 25724, 25735, 25736, 25742, 25771, 25777, 25789, 25790, 25791, 25793, 25794, 25796, 25801, 25806, 25810, 25814, 25832, 25900, 26422, 26439, 26904, 26916, 27253, 27443, 27467, 27475, 27610, 28152

25849 (ANL/RE–93/4) **Free vibration analysis of a tank containing two liquids.** Tang, Yu; Chang, Y.W. Argonne National Lab., IL (United States). May 1993. 34p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. Order Number DE93015437. Source: OSTI; NTIS; GPO Dep.

A study of the dynamic characteristics of rigidly supported upright circular cylindrical tanks containing two different liquids is presented. The governing differential equations for the tank-two liquid system are obtained by application of the Rayleigh-Ritz procedure in combination with Lagrange's equation. The response functions examined include the fundamental natural frequency, the associated mode of vibration and hydrodynamic pressure exerted against the tank wall. Unlike the cases of tanks containing one liquid in which the dynamic response is controlled by four parameters, the dynamic response of a tank that contains two liquids is controlled by six parameters. The numerical results are presented in tabular and graphic forms, and are compared with those of the

identical tank filled with one liquid. Also, a simple approximate equation for evaluating the fundamental natural frequency for preliminary design is proposed.

25850 (BNL–52372) **Dynamic soil pressures on rigid cylindrical vaults.** Veletsos, A.S. (Rice Univ., Houston, TX (United States)); Younan, A.H. Brookhaven National Lab., Upton, NY (United States). Feb 1993. 57p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. Order Number DE93013930. Source: OSTI; NTIS; GPO Dep.

A critical evaluation is made of the dynamic pressures and the associated forces induced by ground shaking on an upright, circular, rigid vault that is embedded in a uniform viscoelastic stratum of constant thickness and infinite extent in the horizontal plane. Both the vault and the stratum are presumed to be supported on a nondeformable base undergoing a space-invariant, uniform horizontal motion. The effects of both harmonic and earthquake-induced excitations are examined. Simple approximate expressions for the responses of the system are formulated, and comprehensive numerical data are presented which elucidate the underlying response mechanisms and the effects and relative importance of the various parameters involved. The parameters investigated include the height to radius ratio for the vault, the conditions at the vault-medium interface, and the material properties of the stratum. In addition to valuable insights into the response of the particular system being examined, the results presented provide a conceptual framework for the analysis and interpretation of solutions for more involved systems as well.

25851 (CONF-9304128–3) **Off-site contamination at Oak Ridge National Laboratory.** Setaro, J.A. Oak Ridge National Lab., TN (United States). [1993]. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Department of Energy (DOE) radiation protection conference; Las Vegas, NV (United States); 13-15 Apr 1993. Order Number DE93012962. Source: OSTI; NTIS; INIS; GPO Dep.

An upgrade of the radioactive liquid waste system at Oak Ridge National Laboratory (ORNL) had been under way for the past several years. One of the upgrades involves the construction of a Monitoring and Control Station (MCS) which will receive waste from an analytical chemistry building prior to the waste being discharged to the main waste processing area. The MCS was located in a radiologically clean area adjacent to the analytical chemistry facility and no monitoring of personnel was necessary. On December 29, 1992, workers became contaminated and left the site prior to the discovery of the contamination. The construction workers were not employees of the Facility Management Contractor, Martin Marietta Energy Systems, but were subcontractor employees answering to the Construction Manager, a different prime contractor.

25852 (DOE/CH/10324–T9) **Southern state radiological emergency preparedness and response plans: A collection of matrices.** Southern States Energy Board, Norcross, GA (United States). Jul 1989. 22p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC01-87CH10324. Order Number DE93016306. Source: OSTI; NTIS; INIS; GPO Dep.

The Southern States Energy Board (SSEB) is an interstate compact organization that serves 16 states and the Commonwealth of Puerto Rico with information and analysis in energy and environmental matters. Technical support and services are offered in a variety of areas, including renewable and alternative energy technologies; energy conservation; acid rain; utility regulation; clean coal technologies and technology transfer, oil and natural gas supply; and solid, hazardous and radioactive materials management. SSEB has received support from the US Department of Energy for the regional analysis of high-level radioactive waste transportation issues. In the performance of its work in this area, SSEB formed the advisory Committee on High-Level Radioactive Materials Transportation, which comprises representatives from affected states and tribes. Among the waste transportation issues considered by SSEB and the committee are shipment routing, the impacts of Monitored Retrievable Storage, state liability in the event of an accident and emergency preparedness and response. This document addresses the latter by identifying the major elements of southern state emergency preparedness and response programs.

25853 (DOE/CH/10324–T13) **Southern states radiological emergency response laws and regulations.** Southern States Energy Board, Norcross, GA (United States). Feb 1989. 32p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC01-87CH10324. Order Number DE93016310. Source: OSTI; NTIS; INIS; GPO Dep.

The radiological emergency response laws and regulations of the Southern States Energy Compact member states are in some cases disparate. Several states have very specific laws on radiological emergency response while in others, the statutory law mentions only emergency response to "natural disasters." Some states have adopted extensive regulations on the topic; others have none. For this reason, any general overview must necessarily discuss laws and regulations in general terms.

25854 (DOE/CH/10324–T17) **Southern states radiological emergency response laws and regulations.** Southern States Energy Board, Norcross, GA (United States). Jun 1990. 45p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC01-87CH10324. Order Number DE93016314. Source: OSTI; NTIS; INIS; GPO Dep.

The purpose of this report is to provide a summary of the emergency response laws and regulations in place in the various states within the southern region for use by legislators, emergency response planners, the general public and all persons concerned about the existing legal framework for emergency response. SSEB expects to periodically update the report as necessary. Radiation protection regulations without emergency response provisions are not included in the summary. The radiological emergency response laws and regulations of the Southern States Energy Compact member states are in some cases disparate. Several states have very specific laws on radiological emergency response while in others, the statutory law mentions only emergency response to "natural disasters." Some states have adopted extensive regulations on the topic, others have none. For this reason, any general overview must necessarily discuss laws and regulations in general terms. State-by-state breakdowns are given for specific states.

25855 (DOE/EH–0317) **Environment, safety and health progress assessment of the Lawrence Livermore National Laboratory.** USDOE, Washington, DC (United States). Nov 1992. 257p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93012804. Source: OSTI; NTIS; GPO Dep.

This report documents the result of the US Department of Energy (DOE) Environment, Safety and Health (ES&H) Progress Assessment of the Lawrence Livermore National Laboratory (LLNL) in Livermore, California. The onsite assessment, which was conducted from November 9 through November 20, 1992, included a selective review of the ES&H management systems and programs with principal focus on the Office of the Assistant Secretary for Defense Programs (DP); San Francisco Field Office (SF), including the Livermore Site Office (LSO); and the site contractor, the University of California. The purpose of the LLNL ES&H Progress Assessment is to provide the Secretary with an independent assessment of the adequacy and effectiveness of the DOE and contractor management structures, resources, and systems to address ES&H issues and requirements. The assessment was not a comprehensive compliance assessment of ES&H activities. The point of reference for assessing programs at LLNL was, for the most part, the Tiger Team Assessment of LLNL, which was conducted from February 26 through April 5, 1990. The LLNL Progress Assessment was conducted by a team of 12 professionals from various DOE offices and their support contractors, with expertise in the areas of management, environment, safety, and health. The Progress Assessment Team concluded that LLNL management recognizes the importance that the Secretary of Energy places on ES&H excellence and has responded with improvements in all ES&H areas. Progress has been made in addressing the deficiencies identified in the 1990 Tiger Team Assessment. Although much remains to be done and concerns were noted in several areas, these concerns do not diminish the significance of the progress made since the 1990 Tiger Team Assessment.

25856 (DOE/EIS–0185D-074-Vol.2) **Remedial investigation for the chemical plant area of the Weldon Spring Site: Volume 2.** USDOE Oak Ridge Field Office, TN (United States). Weldon

Spring Site Remedial Action Project; MK-Ferguson Co., Weldon Spring, MO (United States); Jacobs Engineering Group, Inc., Weldon Spring, MO (United States). Nov 1992. 424p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-86OR21548. (DOE/OR/21548–074-Vol.2). Order Number DE93003927. Source: OSTI; NTIS; INIS; GPO Dep.

Engineering drawings for this project are identified as CAPE-3064. Inquiries may be directed to: Office of Scientific and Technical Information, P.O. Box 62, Oak Ridge, TN 37831.

This volume contains figures such as charts and maps identifying areas of contamination, and tables of compiled data on the types and amount of contamination.

25857 (DOE/FTR–93013119) **Travel to United Kingdom and Germany to transfer foreign landfill barrier and stabilization technologies both to and from the US Department of Energy complex sites: Foreign trip report, March 4–June 30, 1992.** Phillips, S.J. Westinghouse Hanford Co., Richland, WA (United States). 24 Aug 1992. 153p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE93013119. Source: OSTI; NTIS (US Sales Only); GPO Dep.

A review of United Kingdom (UK) and German technologies and materials for remediation of radioactive and/or hazardous waste landfill sites was made and documented as a result of a short-term foreign appointment. A working data base of materials for in situ treatment of landfills was compiled and recorded on DBASE IV software. Alternative technologies and equipment example engineering sketches were made. These illustrations are categorized relative to in situ treatment by physical, chemical, and thermal processes. Data base and technology engineering sketches have been sent to integrated demonstration and integrated program coordinators. A short form technical task plan (TTP) was written by the US and UK research engineers proposing a cooperative US private sector, DOE complex, and UK nuclear industry cooperative technology demonstration. This TTP delineates work to demonstrate contaminated media surface treatment with polymeric and granular materials at atmospheric weapons testing sites in Australia, the Christmas Islands, and the Marshall Islands. Foreign landfill stabilization technologies identified and evaluated for potential application at DOE sites are, for the most part, applicable if site treatment is limited to barrier placement. Further development of in situ treatment technologies that directly access the wasteform or contaminant plumes originating from the wasteform is required. Both UK and German development engineers and scientists are very supportive of cooperative landfill stabilization and general remediation demonstration efforts.

25858 (DOE/IG–0326) **Fernald Environmental Management Project remedial investigation and feasibility study.** Layton, J.C. USDOE Office of Inspector General, Oak Ridge, TN (United States). Eastern Regional Audit Office. 15 Apr 1993. 37p. Sponsored by USDOE, Washington, DC (United States). Source: OSTI (Free of Charge); INIS.

Environmental restoration involves the cleanup and restoration of US Department of Energy (DOE) sites and facilities contaminated with hazardous substances during past production or disposal activities. An important element of the environmental restoration process is the remedial investigation and feasibility study (RI/FS), which is designed to determine the extent of contamination and to identify alternatives for cleanup. The Office of the Assistant Secretary for Environmental Restoration and Waste Management is responsible for policy direction and oversight of DOE's environmental restoration program. The objective of the audit was to determine whether DOE and its contractors had developed effective management control systems to ensure that maximum benefits were obtained from the funds spent on the RI/FS at the Fernald Environmental Management Project. Although DOE had improved the Fernald RI/FS project over the previous 18 months, the project at Fernald was not planned and controlled cost effectively. This condition occurred because (1) DOE and its contractors lacked experience in the RI/FS process, (2) DOE and its contractors had not communicated effectively with one another and outside regulators, and (3) DOE had not placed enough emphasis on management control systems. As a result, after about 6 years and the expenditure of over $100 million on the RI/FS project at Fernald, DOE and the Environmental Protection Agency (EPA) had made no decisions as to future land use, cleanup methods, disposal sites, or the level of environmental protection needed for the site. For each year that the completion of the RI/FS and cleanup is unnecessarily delayed, DOE will be required to spend about $149 million to support site infrastructure costs. Finally, DOE was planning for the possible construction of waste storage buildings, estimated to cost $2.6 billion, when the need for the buildings had not been validated.

25859 (DOE/IG–0327) **The remedial investigation/feasibility study process at Oak Ridge National Laboratory.** USDOE Office of Inspector General, Oak Ridge, TN (United States). Eastern Regional Audit Office. 27 Apr 1993. 62p. Sponsored by USDOE, Washington, DC (United States). Source: OSTI (Free of Charge); INIS.

Report to the Secretary.

Martin Marietta Energy Systems, Inc. (Energy Systems), manages and operates the Oak Ridge National Laboratory (ORNL), Oak Ridge, Tennessee, under a cost-plus-award-fee contract administered by the Department of Energy's (DOE) Oak Ridge Field office (Field Office). Energy Systems' environmental restoration program is responsible for eliminating or reducing to prescribed safe levels the risks to the environment or to human health and safety posed by inactive and surplus sites and facilities that have been contaminated with radioactive, hazardous, or mixed wastes. Energy Systems subcontracted to perform the remedial investigation and feasibility study (RI/FS) at ORNL. The objective of our audit was to determine if the RI/FS at ORNL had been implemented in a manner that ensured accomplishment of the goals and objectives of the DOE Environmental Restoration Program. The audit disclosed that the subcontractor did not fully meet its contractual requirements. Specifically, environmental data produced by the subcontractor is of questionable value for meeting its contractual requirement to provide data supporting permanent remedial action. This condition occurred because neither the subcontractor nor Energy Systems adequately implemented all essential management controls, and neither Energy Systems nor DOE provided adequate contract administration. As a result, DOE has received little value for its RI/FS expenditures. We have recommended that DOE determine the allowability of an estimated $45 million of subcontractor RI/FS cost at ORNL, plus the cost of Energy Systems administering the subcontract. Furthermore, DOE will continue to pay unnecessary costs and experience cost growth and project delays until effective project management controls are implemented.

25860 (DOE/RL–92-18) **Semiworks source aggregate area management study report.** USDOE Richland Field Office, WA (United States). May 1993. 502p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93013051. Source: OSTI; NTIS; INIS; GPO Dep.

This report presents the results of an aggregate area management study (AAMS) for the Semi-Works Aggregate Area in the 200 Areas of the US Department of Energy (DOE) . Hanford Site in Washington State. This scoping level study provides the basis for initiating Remedial Investigation/Feasibility Study (RI/FS) activities under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) or Resource Conservation and Recovery Act (RCRA) Facility Investigations WD and Corrective Measures Studies (CMS) under RCRA. This report also integrates select RCRA treatment storage, or disposal (TSD) closure activities with CERCLA and RCRA past-practice investigations. This approach is described and justified in The Hanford Federal Facility Agreement and Consent Order Change Package. This strategy provides new concepts for: accelerating decision-malting by maximizing the use of existing data consistent with data quality objectives (DQOs); and undertaking expedited response actions (ERAS) and/or interim remedial measures (IRMs), as appropriate, to either remove threats to human health and welfare and the environment, or to reduce risk by reducing toxicity, mobility, or volume of contaminants.

25861 (DOE/RL–92-21-Rev.1) **300-FF-1 physical separations CERCLA treatability test plan: Revision 1.** USDOE Richland Field Office, WA (United States). May 1993. 58p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93014915. Source: OSTI; NTIS; INIS; GPO Dep.

This test plan describes specifications, responsibilities, and general procedures to be followed to conduct physical separations soil treatability tests in the north process pond of the 300-FF-1 Operable Unit at the Hanford Site. The overall objective of these tests is to evaluate the use of physical separations systems as a means of concentrating chemical and radioactive contaminants into fine soil fractions, and thereby minimizing waste volumes. If successful, the technology could be applied to clean up millions of cubic meters of contaminated soils at Hanford and other sites. In this document, physical separations refers to a simple and comparatively low cost technology to potentially achieve a significant reduction in the volume of contaminated soils without the use of chemical processes. Removal of metals and radioactive contaminants from the fine fraction of soils may require additional treatment such as chemical extraction, electromagnetic separation, or stabilization. Investigations/testing of these technologies are recommended to assess the economic and technical feasibility of additional treatment, but are not within the scope of this test. This plan provides guidance and specifications for two proposed treatability tests: one to be conducted by Westinghouse Hanford Company; and another proposed as competitive bid service contract. The main body of this test plan discusses the tests in general and items that are common to both tests. Attachment A discusses in detail the EPA system test and Attachment B discusses the vendor test.

25862 (DOE/UMTRA–050506-Vol.3-App.F) **Remedial action plan and site design for stabilization of the inactive uranium mill tailings sites at Rifle, Colorado: Final report: Volume 3, Appendix F, Final design, specifications, and drawings.** US-DOE Albuquerque Field Office, NM (United States). Uranium Mill Tailings Remedial Action Project Office; Colorado State Government, Denver, CO (United States). Feb 1992. 312p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC04-82AL16257. Order Number DE93012928. Source: OSTI; NTIS; GPO Dep.

Engineering drawings for this project are identified as CAPE-3054. Inquiries may be directed to: Office of Scientific and Technical Information, P.O. Box 62, Oak Ridge, TN 37831.

This volume contains Appendix F, bid schedule and specifications for remedial action on three sites: Old Rifle processing site; New Rifle processing site and Estes Gulch disposal site.

25863 (EGG-M–93135) **Pit 9 project: A private sector initiative.** Macdonald, D.W. (USDOE Idaho Field Office, Idaho Falls, ID (United States)); Hughes, F.P.; Burton, B.N. EG and G Idaho, Inc., Idaho Falls, ID (United States). [1993]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. (CONF-930873–7: 2. international mixed waste symposium, Baltimore, MD (United States), 17-20 Aug 1993). Order Number DE93013677. Source: OSTI; NTIS; INIS; GPO Dep.

This report discusses the Pit 9 Comprehensive Demonstration which is intended to demonstrate a cost-effective approach to remediate an Idaho National Engineering Laboratory (INEL) waste disposal pit through a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Interim Action. The remediation will include additional requirements, if needed, to provide high confidence that only minor additional work would be necessary to accomplish the final closure as part of the overall final closure strategy for the INEL's Subsurface Disposal Area (SDA).

25864 (EGG-WTD–10717) **Test plan for the field evaluation and demonstration of the Contamination Control Unit.** Winberg, M.R.; Thompson, D.N. EG and G Idaho, Inc., Idaho Falls, ID (United States). Jun 1993. 58p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. Order Number DE93016636. Source: OSTI; NTIS; INIS; GPO Dep.

This report describes test details of a full demonstration of the Contamination Control Unit (CCU). The CCU is a mobile trailer capable of employing the use of soil fixatives, dust suppression agents, misting, and vacuum systems. These systems can perform a large number of contamination control functions to support the Office of Waste Technology Development (OTD) Buried Waste Integrated Demonstration (BWID) projects, transuranic (TRU) waste retrieval operations, and emergency response for hazardous and radioactive materials incidents. The demonstration will include both performance testing at the North Holmes Laboratory Facility (NHLF) and field testing in conjunction with the Remote Excavation System Demonstration at the Cold Test Pit. The NHLF will test operational parameters using water only, and the field demonstration at the Cold Test Pit involves full scale operation of vacuum, fixant, misting, and dust suppression systems. Test objectives, detailed experimental procedures, and data quality objectives necessary to perform the field demonstration are included in this test plan.

25865 (ES/ER/TM–59) **Environmental Restoration Program pollution prevention performance measures for FY 1993 and 1994 remedial investigations.** Oak Ridge National Lab., TN (United States); Weston (Roy F.), Inc., Oak Ridge, TN (United States). Mar 1993. 42p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93010884. Source: OSTI; NTIS; INIS; GPO Dep.

The Martin Marietta Energy Systems, Inc., Environmental Restoration (ER) Program adopted a Pollution Prevention Program in March 1991. The program's mission is to minimize waste and prevent pollution in remedial investigations (RI), feasibility studies (FS), decontamination and decommissioning (D&D), and surveillance and maintenance (S&M) site program activities. Mission success will result in volume and/or toxicity reduction of generated waste. Energy Systems is producing a fully developed a Numerical Scoring System (NSS) and actually scoring the generators of Investigation Derived Waste (IDW) at six ER sites: Oak Ridge National Laboratory (ORNL), the Oak Ridge Y-12 Plant, the Oak Ridge K-25 site, Paducah Gaseous Diffusion Plant (Paducah), and Portsmouth Uranium Enrichment Complex (Portsmouth). This report summarizes the findings of this initial numerical scoring evaluation and shows where improvements in the overall ER Pollution prevention program may be required. This report identifies a number of recommendations that, if implemented, would help to improve site-performance measures. The continued development of the NSS will support generators in maximizing their Pollution Prevention/Waste Minimization efforts. Further refinements of the NSS, as applicable suggest comments and/or recommendations for improvement.

25866 (HW–18846) **Outline of proram for testing air-supplied face masks used in P-10 atmospheres.** Adley, F.E. Hanford Works, Richland, WA (United States). 11 Sep 1950. 2p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93017352. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report consists of an outline for a program for testing the air-supplied face masks currently being used as protection against P-10 atmospheres at HAPO. The test procedures which follow are intended to determine circumstances under which the mask ceases to offer protection to the wearer. To keep the scope of the test program to a minimum and also to facilitate interpretation of the findings in the light of P-10 atmospheres, the test conditions chosen were those which would be most unfavorable for the mask from a protection standpoint.

25867 (HW–27570) **Radiation exposure rates in the 222-S Process Control Laboratory.** Helgeson, G.L. Hanford Works, Richland, WA (United States). 1 Apr 1953. 31p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93017353. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The objective of this study is to provide a simple method for calculating exposures for the various laboratory procedures which involve penetrating radiations. With this method it will be possible to evaluate and record on a day to day basis the total exposure received during laboratory work. It will also provide reliable information for exposure investigations.

25868 (PNL–8598) **A strategic analysis study-based approach to integrated risk assessment: Occupational health risks from environmental restoration and waste management activities at Hanford.** Mahaffey, J.A. (Pacific Northwest Lab., Richland, WA (United States)); Doctor, P.G.; Buschbom, R.L.; Glantz, C.S.; Daling, P.M.; Sever, L.E.; Vargo, G.J. Jr.; Strachan, D.M.; Pajunen, A.L.; Hoyt, R.C.; Ludowise, J.D. Pacific Northwest Lab., Richland, WA (United States). Jun 1993. 86p. Sponsored by

USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93016577. Source: OSTI; NTIS; GPO Dep.

The goal of environmental restoration and waste management activities is to reduce public health risks or to delay risks to the future when new technology will be available for improved cleanup solutions. Actions to remediate the wastes on the Hanford Site will entail risks to workers, the public, and the environment that do not currently exist. In some circumstances, remediation activities will create new exposure pathways that are not present without cleanup activities. In addition, cleanup actions will redistribute existing health risks over time and space, and will likely shift health risks to cleanup workers in the short term. This report describes an approach to occupational risk assessment based on the Hanford Strategic Analysis Study and illustrates the approach by comparing worker risks for two options for remediation of N/K fuels, a subcategory of unprocessed irradiated fuels at Hanford.

25869 (PNL-SA–21832) **Potential CERCLA reauthorization issues relevant to US DOE's Environmental Restoration Program.** Siegel, M.R. (Pacific Northwest Lab., Richland, WA (United States)); McKinney, M.D.; Jaksch, J.A.; Dailey, R.L. Pacific Northwest Lab., Richland, WA (United States). Feb 1993. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-930205–36: Waste management '93, Tucson, AZ (United States), 28 Feb - 4 mar 1993). Order Number DE93009481. Source: OSTI; NTIS; INIS; GPO Dep.

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) is currently scheduled to be reauthorized in 1994. The US Department of Energy (DOE) has a significant stake in CERCLA reauthorization. CERCLA, along with its implementing regulation, the National Contingency Plan (NCP), is the principal legal authority governing DOE's environmental restoration program. The manner in which CERCLA-related issues are identified, evaluated, and dispatched may have a substantial impact on DOE's ability to conduct its environmental restoration program. A number of issues that impact DOE's environmental restoration program could be addressed through CERCLA reauthorization. These issues include the need to (1) address how the National Environmental Policy Act (NEPA) should be integrated into DOE CERCLA actions, (2) facilitate the streamlining of the Superfund process at DOE sites, (3) address the conflicts between the requirements of CERCLA and the Resource Conservation and Recovery Act (RCRA) that are especially relevant to DOE, (4) examine the criteria for waiving applicable or relevant and appropriate requirements (ARARs) at DOE sites, and (5) delineate the appropriate use of institutional controls at DOE sites.

25870 (PNL-SA–21870) **Investigation of potential for occurrence of molten soil displacement events during in situ vitrification of combustible wastes.** Roberts, J.S.; Strachan, C.W.; Luey, J. Pacific Northwest Lab., Richland, WA (United States). Feb 1993. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830 ;FG06-89ER75522. (CONF-930205–51: Waste management '93, Tucson, AZ (United States), 28 Feb - 4 mar 1993). Order Number DE93010166. Source: OSTI; NTIS; INIS; GPO Dep.

Computer simulations are used to investigate the application of in situ vitrification (ISV) for processing contaminated soil containing high loadings of solid, compressible waste material, typical of landfills and solid waste trenches. Specifically, these simulations predict whether significant displacement of molten soil, due to large, 1 to 2 m diameter, gas bubbles rising up through the ISV melt, are likely to occur during processing of combustible waste-loaded sites. These bubbles are believed to originate from high-pressure regions below the melt caused by vaporization of water and gases generated by the combustion, volatilization, or pyrolyzation of combustible materials in the waste. Simulations were run using the TOUGH2 computer code to predict pressures underneath the ISV melt TOUGH2 is an unsaturated groundwater modeling code capable of treating non-isothermal problems. These simulations include moving melt front and simple pyrolysis models and investigate how the gas pressure in the soil below the melt is affected by melt progression rate, soil permeability, combustible and impermeable material loading. The following conclusions have been drawn based on the TOUGH2 simulations.

25871 (PNL-SA–21879) **Statistical evaluation of cleanup: How should it be done?.** Gilbert, R.O. Pacific Northwest Lab., Richland, WA (United States). Feb 1993. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-930205–47: Waste management '93, Tucson, AZ (United States), 28 Feb - 4 mar 1993). Order Number DE93010171. Source: OSTI; NTIS; INIS; GPO Dep.

This paper discusses statistical issues that must be addressed when conducting statistical tests for the purpose of evaluating if a site has been remediated to guideline values or standards. The importance of using the Data Quality Objectives (DQO) process to plan and design the sampling plan is emphasized. Other topics discussed are: (1) accounting for the uncertainty of cleanup standards when conducting statistical tests, (2) determining the number of samples and measurements needed to attain specified DQOs, (3) considering whether the appropriate testing philosophy in a given situation is "guilty until proven innocent" or "innocent until proven guilty" when selecting a statistical test for evaluating the attainment of standards, (4) conducting tests using data sets that contain measurements that have been reported by the laboratory as less than the minimum detectable activity, and (5) selecting statistical tests that are appropriate for risk-based or background-based standards. A recent draft report by Berger that provides guidance on sampling plans and data analyses for final status surveys at US Nuclear Regulatory Commission licensed facilities serves as a focal point for discussion.

25872 (PNL-SA–21891) **Graphite electrode dc arc technology development for treatment of buried wastes.** Surma, J.E. (Pacific Northwest Lab., Richland, WA (United States)); Cohn, D.R.; Smatlak, D.L.; Thomas, P.; Woskov, P.P.; Titus, C.H.; Wittle, J.K.; Hamilton, R.A. Pacific Northwest Lab., Richland, WA (United States). Feb 1993. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-930205–1: Waste management '93, Tucson, AZ (United States), 28 Feb - 4 mar 1993). Order Number DE93009814. Source: OSTI; NTIS; INIS; GPO Dep.

A "National Laboratory-University-Industrial" three-way partnership has been established between the Pacific Northwest Laboratory (PNL), Massachusetts Institute of Technology (MIT), and Electro-Pyrolysis, Inc. (EPI) to develop graphite electrode DC arc technology for the treatment of buried wastes. This paper outlines the PNL-MIT-EPI program describing a series of engineering-scale DC arc furnace tests conducted in an EPI furnace at the Plasma Fusion Center at MIT, and a description of the second phase of this program involving the design, fabrication, and testing of a pilot-scale DC arc furnace. Included in this work is the development and implementation of diagnostics to evaluate and optimize high temperature thermal processes such as the DC arc technology.

25873 (PNL-SA–21895) **Involving stakeholders in evaluating environmental restoration technologies.** McCabe, G.H. (Battelle Seattle Research Center, WA (United States)); Serie, P.J. Pacific Northwest Lab., Richland, WA (United States). Feb 1993. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-930205–43: Waste management '93, Tucson, AZ (United States), 28 Feb - 4 mar 1993). Order Number DE93009812. Source: OSTI; NTIS; INIS; GPO Dep.

Involving citizens, interest groups, and regulators in environmental restoration and waste management programs is a challenge for government agencies and the organizations that support them. To be effective, such involvement activities must identify all individuals and groups who have a stake in the cleanup. Their participation must be early, substantive, and meaningful. Stockholders must be able to see how their input was considered and used, and feel that a good- faith effort was made to reconcile conflicting objectives. The Integrated Demonstration for Cleanup of Volatile Organic Compounds at Arid Sites (VOC-Arid ID) is a Department of Energy Office of Technology Development project located at Hanford. Along with technical evaluation of innovative cleanup technologies, the program is conducting an institutional assessment of regulatory and public acceptance of new technologies. Through a series of interviews and workshops, and use of a computerized information

management tool, stakeholders are having a voice in the evaluation. Public and regulatory reaction has been positive.

25874 (PNL-SA-21987) **Implementation of in situ vitrification technology for remediation of Oak Ridge contaminated soil sites: Past results and future plans.** Tixier, J.S. (Pacific Northwest Lab., Richland, WA (United States)); Powell, T.D.; Spalding, B.P.; Jacobs, G.K. Pacific Northwest Lab., Richland, WA (United States). Feb 1993. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830 ;AC05-84OR21400. (CONF-930205--52: Waste management '93, Tucson, AZ (United States), 28 Feb - 4 mar 1993). Order Number DE93010172. Source: OSTI; NTIS; INIS; GPO Dep.

In situ vitrification is a thermal treatment technology being developed for remediation of contaminated soils. The process transforms easily leached, contaminated soils into a durable, leach-resistant. vitreous and crystalline monolith. This paper presents the results of the recent highly successful ISV demonstration conducted jointly by PNL and ORNL on a tracer-level quantity of radioactive sludge in a model trench at ORNL. A retention of ^{90}r in the vitreous and crystalline product of greater than 99.9999% was measured with a reduction in potential environmental mobility of more than two orders of magnitude. The paper also presents the current plans for continued collaboration on a two-setting treatability test on one portion of an old seepage pit at ORNL.

25875 (RFP-4714) **Implementation of DOE Order 5480.23 and 5480.22 Nuclear Safety Analysis Reports and technical safety requirements at EG&G Rocky Flats.** Satterwhite, D.; Reed, A. EG and G Rocky Flats, Inc., Golden, CO (United States). Rocky Flats Plant. [1993]. 2p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC34-90DP62349. (CONF-9306143--Summ.: Energy Facility Contractors Group safety analysis meeting, Denver, CO (United States), 16-18 Jun 1993). Order Number DE93015412. Source: OSTI; NTIS; INIS; GPO Dep.

Short communication. ROCKY FLATS PLANT/safety analysis; REMEDIAL ACTION; REGULATIONS; IMPLEMENTATION; SAFETY; PLANNING

25876 (RFP-4723) **Development of an ambient air sampler that satisfies RF plant monitoring requirements.** Nininger, R.C.; Pauley, B.J. EG and G Rocky Flats, Inc., Golden, CO (United States). Rocky Flats Plant. [1993]. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC34-90DP62349. (CONF-9305193--1: 2. EG&G GOCO environmental conference, Idaho Falls, ID (United States), 12-14 May 1993). Order Number DE93012703. Source: OSTI; NTIS; INIS; GPO Dep.

EG&G Rocky Flats Plant (RFP) is developing a new ambient air particulate sampler to replace units that have been in service for about twenty years. The new sampler is required to operate at a flow rate approximately twice that of the existing samplers and admit particles as large as 70 micrometers aerodynamic diameter. The sampler provides two size fractions with separation at 10 micrometers. using a single stage impactor designed at RFP and carrying a Department of Energy (DOE) patent. The sampler is modular for easy servicing in the field and its operation can be checked via radiotelemetry. The sampler, designed to meet Environmental Protection Agency (EPA) requirements for PM-10 sampling, is currently being characterized in EPA's laboratories at Research Triangle Park, North Carolina.

25877 (SAND-92-2296C) **Cross borehole electromagnetic imaging of chemical and mixed waste landfills.** Borns, D.J. (Sandia National Labs., Albuquerque, NM (United States)); Newman, G.; Stolarczyk, L.; Mondt, W. Sandia National Labs., Albuquerque, NM (United States). [1992]. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9304109--4: SAGEEP '93: symposium on the application of geophysics to environmental and engineering problems, San Diego, CA (United States), 18-21 Apr 1993). Order Number DE93011684. Source: OSTI; NTIS; INIS; GPO Dep.

The Mixed Waste Landfill Integrated Demonstration (MWLID) is testing noninvasive site characterization methods at several locations, including the Chemical Waste Landfill (CWL) at Sandia National Laboratories. The CWL comprises shallow, unlined pits that were used for the disposal of acids, oils, solvents, and inorganic compounds from 1962 until the CWL was closed in 1985. The soils of the landfills are alluvial, predominantly sand, gravels and cobbles with small quantities of silts and clays. The focus of this study is an unlined chromic acid pit (UCAP). The UCAP pit is rectangular (approximately 4 × 10 m), which reportedly received unknown volumes of chromium in the form of chromic acid (liquid) and other hazardous materials. At this location, we have demonstrated a continuous waveform (CW) system for site characterization. During this year, we will also utilize a crossborehole pulsed radar system. Both methods are sensitive to variations in either electrical conductivity or dielectric constant in the soils or host rock at a waste site. These earth properties are some of the most responsive geophysical indicators of metallic, acidic and water-based subsurface contaminants.

25878 (SAND-93-0463C) **Fire accident analysis modeling in support of non-reactor nuclear facilities at Sandia National Laboratories.** Restrepo, L.F. Sandia National Labs., Albuquerque, NM (United States). [1993]. 2p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9306143--4: Energy Facility Contractors Group safety analysis meeting, Denver, CO (United States), 16-18 Jun 1993). Order Number DE93015123. Source: OSTI; NTIS; GPO Dep.

The Department of Energy (DOE) requires that fire hazard analyses (FHAs) be conducted for all nuclear and new facilities, with results for the latter incorporated into Title I design. For those facilities requiring safety analysis documentation, the FHA shall be documented in the Safety Analysis Reports (SARs). This paper provides an overview of the methodologies and codes being used to support FHAs at Sandia facilities, with emphasis on SARs.

25879 (UCRL-ID-104857) **Creep of clad irradiation as an uncertainty in criticality safety margins that include the effects of burnup for pressurized water reactor fuel assemblies.** Carlson, R.W.; Fischer, L.E. Lawrence Livermore National Lab., CA (United States). Sep 1990. 34p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93012384. Source: OSTI; NTIS; INIS; GPO Dep.

The uncertainties that must be associated with the effects of burnup when predicting the criticality safety margin of a spent fuel transport or storage cask must include allowances for phenomena that are not included in the prediction of the effects of burnup. One such phenomena is the creep of the clad during irradiation of fuel rods, which reduces the diameter of the clad as burnup progresses. The fuel management analyses of a power reactor are based upon unit cell calculations of the neutron spectrum that do not typically include reduction in the diameter of the clad due to creep. The analyses presented here evaluate the magnitude of the effects of creep and conclude that an uncertainty of 0.3% ($\delta k/k$) should be assigned to the effects of creep. This uncertainty should be included with the other uncertainties to allow for the increase in the effective multiplication factor of a spent fuel cask that results from the changes in the isotopic inventories of uranium and plutonium in the fuel due to the effects of creep.

25880 (UCRL-JC-110983) **Guidelines for the development of natural phenomena hazards design criteria for surface facilities.** Nelson, T.A.; Hossain, Q.A.; Murray, R.C. Lawrence Livermore National Lab., CA (United States). 25 Jun 1992. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-920866--6: American Society of Civil Engineers (ASCE) symposium on dynamic analysis and design considerations, for high-level nuclear waste repositories, San Francisco, CA (United States), 19-20 Aug 1992). Order Number DE93012500. Source: OSTI; NTIS; INIS; GPO Dep.

This paper discusses the rationale behind the guidelines, criteria, and methodologies that are currently used for natural phenomena hazard design and evaluation of DOE nuclear and non-nuclear facilities. The bases for the performance goals and usage categories specified in UCRL-15910 are examined, and the sources of intentional conservatism in the analyses, design, and evaluation methods and criteria are identified. Outlines of recent developments/changes in DOE Orders related to Natural Phenomena hazard mitigation are also presented. Finally, the authors recommend the use of DOE methodologies as embodied in UCRL-15910

for design and evaluation of surface facilities of the high level nuclear waste repository site.

25881 (WHC-SA–1706) **Case study: Managing potentially contaminated records.** Sprouse, B.S. Westinghouse Hanford Co., Richland, WA (United States). Jun 1993. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (CONF-9306156–1: Records management conference: ARMA material, Seattle, WA (United States), 14-17 Jun 1993). Order Number DE93016226. Source: OSTI; NTIS; INIS; GPO Dep.

For the past 10 or more years, Analytical Laboratory data cards have been generated and stored in the 222-S Laboratory at the Hanford Site in Richland, Washington. These cards are classified as record material and require retention for a minimum of 75 years in an approved storage facility in accordance with Westinghouse Hanford Company procedures. The cards are maintained in records boxes in the attic of the 222-S Laboratory and are subject to potential risk and loss. The most significant potential risks are radiological hazards. Various options are available for removal, cataloging, transmittal, and storage of these long-term records. Because the records are currently stored in a radiation protection zone, they surveyed before being released from the facility. This survey can be arduous and time consuming. Resolutions to the problem of removal and proper storage of the records from the facility need to be addressed. The records were reviewed and inventoried to determine the quantity of information. A study of the various options available was conducted, and based on the information collected, it was determined that the most feasible and cost-effective approach is to microfilm the cards inside the laboratory. This option complies with all applicable company requirements and decreases the estimated radiological survey time from approximately 3.5 years to under 40 hours. This activity will result in a potential savings of $350,000 over the life of the activity.

25882 (WHC-SA–1831) **Preliminary standard review guide for Environmental Restoration/Decontamination and Decommissioning safety analyses.** Ellingson, D.R. Westinghouse Hanford Co., Richland, WA (United States). Jun 1993. 36p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (CONF-9306143–13: Energy Facility Contractors Group safety analysis meeting, Denver, CO (United States), 16-18 Jun 1993). Order Number DE93016348. Source: OSTI; NTIS; INIS; GPO Dep.

The review guide is based on the shared experiences, approaches, and philosophies of the Environmental Restoration/ Decontamination and Decommissioning (ER/D&D) subgroup members. It is presented in the form of a review guide to maximize the benefit to both the safety analyses practitioner and reviewer. The guide focuses on those challenges that tend to be unique to ER/ D&D cleanup activities. Some of these experiences, approaches, and philosophies may find application or be beneficial to a broader spectrum of activities such as terminal cleanout or even new operations. Challenges unique to ER/D&D activities include (1) consent agreements requiring activity startup on designated dates; (2) the increased uncertainty of specific hazards; and (3) the highly variable activities covered under the broad category of ER/D&D. These unique challenges are in addition to the challenges encountered in all activities; e.g., new and changing requirements and multiple interpretations. The experiences in approaches, methods, and solutions to the challenges are documented from the practitioner and reviewer's perspective, thereby providing the viewpoints on why a direction was taken and the concerns expressed. Site cleanup consent agreements with predetermined dates for restoration activity startup add the dimension of imposed punitive actions for failure to meet the date. Approval of the safety analysis is a prerequisite to startup. Actions that increase expediency are (1) assuring activity safety; (2) documenting that assurance; and (3) acquiring the necessary approvals. These actions increase the timeliness of startup and decrease the potential for punitive action. Improvement in expediency has been achieved by using safety analysis techniques to provide input to the line management decision process rather than as a review of line management decisions. Expediency is also improved by sharing the safety input and resultant decisions with reviewers and regulators.

25883 (WHC-SA–1839) **Performance audit.** Brisbin, S.A. Westinghouse Hanford Co., Richland, WA (United States). Apr 1993. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (CONF-9309139–1: 20. annual National Energy and Environmental Quality Division conference, Indian Wells, CA (United States), 19-22 Sep 1993). Order Number DE93012614. Source: OSTI; NTIS; GPO Dep.

In today's environmental world, there are essentially two different types of audits: systems audits and performance audits. Performance audits can be used to evaluate precision and accuracy of the total measurement system. The Westinghouse Hanford Company Restoration and Remediation Quality Assurance group conducts performance audits to quantitatively determine the precision and accuracy associated with analytical laboratory data and the comparability of data generated by two different laboratories. This paper explains the methods employed in conducting performance audits at Westinghouse Hanford Company.

25884 (WSRC-MS–92-477-Rev.1) **Risk assessment for nuclear processes at the Savannah River Site: Revision 1.** Durant, W.S. Westinghouse Savannah River Co., Aiken, SC (United States). [1992]. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-930601–18-Rev.1: American Nuclear Society (ANS) annual meeting, San Diego, CA (United States), 20-24 Jun 1993). Order Number DE93013580. Source: OSTI; NTIS; INIS; GPO Dep.

The Savannah River Site, one of the US Department of Energy's nuclear materials processing facilities, has for many years conducted risk-based safety analyses for the nuclear processes conducted at the facilities. This approach has allowed comparisons of risks to established criteria for acceptability. When the risk-based program was begun, it was evident that its success would depend upon having a compilation of data that was site specific. The decision was made to create a data bank of undesirable events that had occurred at the site's nuclear fuel reprocessing facilities. From this modest beginning, five data banks have been created for nuclear fuel reprocessing, waste management, nuclear fuel fabrication, tritium operations, and the Savannah River Technology Center. In addition to the primary purpose of providing a sound basis for risk-based safety analyses, these highly versatile data banks are routinely used for equipment breakdown histories, incident investigations, design studies, project justifications, reliability studies, process problem solving, training, and audits.

25885 (WSRC-TR–93-008) **Demonstration of a utility industry horizontal drilling system: Horizontal well AMH-5 installation report.** Westinghouse Savannah River Co., Aiken, SC (United States). 31 Dec 1992. 168p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93016240. Source: OSTI; NTIS; INIS; GPO Dep.

The Department of Energy's Office of Technology Development initiated an integrated demonstration of innovative technologies and systems for cleanup of VOCs in soils and groundwater at the Savannah River Site (SRS) in 1989. The overall goal of the program is demonstration of multiple technologies and systems in the fields of drilling, characterization, monitoring, and remediation at a single test bed. Innovative technologies are compared to one another and to baseline technologies in terms of technical performance and cost effectiveness. Transfer of successfully demonstrated technologies and systems to DOE environmental restoration organizations, to other government agencies, and to industry is a critical part of the program. Directional drilling has been shown to be a successful technique for enhancing access to the subsurface, thus improving remediation systems, especially remediation systems which perform in situ. Demonstration of an innovative directional drilling system at the Integrated Demonstration Site at the SRS, was initiated in June of 1992. The directional drilling system was designed to install an in situ remediation system. The drilling system is an experimental compaction/dry drilling technique developed by Charles Machine Works (Ditch Witch®) of Perry, Oklahoma. A horizontal well was installed in the M Area of the SRS below and parallel to an abandoned tile process sewer line. The installation of the horizontal well was a two-part process. Part one consisted of drilling the borehole, and part two was the horizontal well completion.

25886 (WSRC-TR–93-102) **Savannah River Site disaggregated seismic spectra.** Stephenson, D.E. Westinghouse Savannah River Co., Aiken, SC (United States). Feb 1993. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93016174. Source: OSTI; NTIS; INIS; GPO Dep.

The objective of this technical note is to characterize seismic ground motion at the Savannah River Site (SRS) by postulated earthquakes that may impact facilities at the site. This task is accomplished by reviewing the deterministic and probabilistic assessments of the seismic hazard to establish the earthquakes that control the hazard to establish the earthquakes that control the hazard at the site and then evaluate the associated seismic ground motions in terms of response spectra. For engineering design criteria of earthquake-resistant structures, response spectra serve the function of characterizing ground motions as a function of period or frequency. These motions then provide the input parameters that are used in the analysis of structural response. Because they use the maximum response, the response spectra are an inherently conservative design tool. Response spectra are described in terms of amplitude, duration, and frequency content, and these are related to source parameters, travel path, and site conditions. Studies by a number of investigators have shown by statistical analysis that for different magnitudes the response spectrum values are different for differing periods. These facts support Jennings' position that using different shapes of design spectra for earthquakes of different magnitudes and travel paths is a better practice than employing a single, general-purpose shape. All seismic ground motion characterization results indicate that the PGA is controlled by a local event with $M_w < 6$ and $R < 30$km. The results also show that lower frequencies are controlled by a larger, more distant event, typically the Charleston source. The PGA of 0.2 g, based originally on the Blume study, is consistent with LLNL report UCRL-15910 (1990) and with the DOE position on LLNL/EPRI.

0550 Safeguards, Inspection, and Accountability

Refer also to citation(s) 25650, 26565, 27249, 27254, 28094, 28167

25887 (DOE/IG–0323) **Review of DOE's personnel security clearance program.** USDOE Office of Inspector General, Washington, DC (United States). Capital Regional Audit Office. 31 Mar 1993. 30p. Sponsored by USDOE, Washington, DC (United States). Source: OSTI (Free of Charge).

Report to the Secretary.

The purpose of this review of the Department of Energy's personnel security program was to determine whether progress had been made in correcting long-standing problems in the program. These problems, as reported earlier, have included issuing too many clearances, granting clearances at too high a level, and not terminating clearances that were no longer needed. Other issues needing corrective action were those relating to slow processing of initial clearances and large reinvestigation backlogs.

25888 (ENEA-RT-NUCL–91-11) **Moisture effects on high level coincidence counter assays of mixed uranium/plutonium oxide.** Stewart, J.E.; Aparo, M.; Zeppa, P.; Troiani, F. Los Alamos National Lab., NM (United States); ENEA, Casaccia (Italy). Area Nucleare; ENEA, Saluggia (Italy). Centro Ricerche Energia. Aug 1991. 28p. (RT/NUCL–91-11). Order Number DE93799290. Source: OSTI; NTIS (US Sales Only); INIS.

The passive neutron coincidence technique is currently used for nondestructive assays of plutonium samples. This technique is based on the measurement of time-correlated neutrons emitted in the spontaneous fission of the even mass number plutonium isotopes. Passive neutron coincidence counting is capable of 1 per cent assay accuracy for pure, well-characterized PuO_2 and MOX samples that contain plutonium masses from a few tens of grams to several kilograms. Unknown amounts of moisture can be present in bulk plutonium samples, due to its hygroscopic characteristics. Such moisture can significantly bias the measurements. The purpose of this work was to establish experimentally and quantitatively the effects of entrained sample moisture on HLNCC assays of MOX samples and to test and calibrate two prototype detectors, developed by Los Alamos National Laboratory, for measuring the amount of moisture in MOX and PuO_2 samples. Further more, a simple system, called PANDA (PAssive Neutron Analyser) used at UMCP facility in order to reduce the burden on the analytical laboratory and to meet the requirements of nuclear material accountability in the balance area, was employed. Results of the experiments established the feasibility of using differential neutron moderation ratios to establish moisture levels in small MOX samples. A procedure for moisture corrections in HLNCC assays was validated experimentally.

25889 (ENEA-RT-NUCL–92-08) **Experience of ENEA in measuring volume and/or mass of input solutions needs for further R&D.** Dionisi, M. ENEA, Casaccia (Italy). May 1992. 18p. (CONF-9203262–1: R&D on volume and mass measurements in liquids, Ispra (Italy), 25-27 Mar 1992; RT/NUCL–92-08). Order Number DE93799246. Source: OSTI; NTIS (US Sales Only); INIS.

Solution volume and mass measurements are an essential component of any system to control and account for nuclear materials that are processed or stored in a liquid medium, both from the operators and the safeguards authorities points of view. ENEA (Italian Agency for Energy, New Technologies and the Environment) engaged a comprehensive R&D programme and, in cooperation with national and international organizations, undertook theoretical and experimental studies on tank volume calibration and measurements in order to fill the recognized technological gap. The ENEA activities included: theoretical and experimental studies; development of an improved time domain reflectometer system for solution level measurement in an accountability tank; in-field testing of tracer techniques for volume and mass determination in accountability tanks. This report presents the experience of ENEA in the field of R&D on solution volume and mass determination; gives impressions and judgements over the state-of-the-art and of practice of these measurements; and provides suggestions on what could and/or must be improved, indicating further R&D activities.

25890 (ETDE-IT–93-179) **Problem dependent nuclear data libraries in activation and dose calculations for 'RB-3' reactor decommissioning.** Cepraga, D.G.; Menapace, E.; Vanossi, A. ENEA, Bologna (Italy). 1992. 4p. (CONF-9209243–2: Advisory group meeting on nuclear data requirements for fission reactor decommissioning, Vienna (Austria), 7-11 Sep 1992). Order Number DE93799266. Source: OSTI; NTIS (US Sales Only); INIS.

In reactor decommissionig (i.e., the process following the final shutdown of the reactor by which radioactive components and materials are removed from the reactor site), a major factor to be taken into account in the methodology is to estimate the radioactive inventory and radiation sources (i.e., the quantities of radioactive materials that may be released into the environment and the resulting doses to the public). A method used for the radioactive inventory calculation and dose evaluation of the CIRENE fuel clusters and ECO fuel elements irradiated in the RB-3 reactor is discussed in this paper with particular regard to the processed problem-dependent nuclear data libraries. A complex sequence of various codes (in particular WIMS-D for flux-weighted spectrum, then flux weight factors calculations) is applied, via the COUPLE code, to update the ORIGEN Library. SCALE-4 modules such as ORIGEN - NITAWL - XSDRNPM - XSDOSE are used to produce problem-dependent processed data libraries needed to perform the depletion and shielding analysis. This sequence involves the systems analysis with associated data processing.

25891 (LA-UR–93-1304) **Statistics applied to safeguards.** Picard, R.R. Los Alamos National Lab., NM (United States). [1993]. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9305190–1: SSAC conference, Santa Fe, NM (United States), 10-14 May 1993). Order Number DE93012644. Source: OSTI; NTIS; GPO Dep.

Statistical methods are central to safeguards work. Measurements forming the basis of much materials accountancy are not perfect - "perfect" in the sense of being error free. Other sessions in this course address the destructive and nondestructive measurement of nuclear material, together with the inherent limitations in those measurements. The bottom line is that measurement errors are a fact of life and, since we can't eliminate them, we have to find a rational way to deal with them. Which leads to the world of

statistics. Beyond dealing with measurement errors, another area of statistical application involves the sampling of items for verification. Inspectors from the IAEA and domestic regulatory agencies periodically visit operating facilities and make measurements of selected items. By comparing their own measured values to those declared by the facilities, increased confidence is obtained. If verification measurements were not expensive, time consuming, and disruptive to operations, perhaps verification of 100% of the inventories would be desirable. In reality, many constraints lead to inspection of only a portion of those inventories. Drawing inferences about a larger "population" of declared items in a facility based on verification information obtained from a sample of those items is a statistical problem. There are few texts on statistics in safeguards. The lengthy exposition "IAEA Safeguards: Statistical Concepts and Techniques" and the US NRC book edited by Bowen and Bennet are two good sources of general information. In the next section, the subject of measurement quality is addressed. The third section covers the evaluation of MUFs, and discusses the related subjects of error propagation and sequential analysis. The final section covers verification, inspection sample size calculations, and the D statistic. The text is written at an elementary level, with references to the safeguards literature for more detailed treatment.

25892 (LA-UR–93-1368) **Fuzzy risk analysis for nuclear safeguards.** Zardecki, A. Los Alamos National Lab., NM (United States). [1993]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930784–1: 5. international Fuzzy Systems Association World Congress, Seoul (Korea, Republic of), 4-9 Jul 1993). Order Number DE93012684. Source: OSTI; NTIS; GPO Dep.

Analysis of a safeguards system, based on the notion of fuzzy sets and linguistic variables, concerns such as complexity and inherent imprecision in estimating the possibility of loss or compromise. The automated risk analysis allows the risk to be determined for an entire system based on estimates for lowest level components and the component proportion. In addition, for each component (asset) the most effective combination of protection mechanisms against a given set of threats is determined. A distinction between bar and featured risk is made.

25893 (LA-UR–93-1669) **Evaluation of three new technologies for international safeguards.** Stanbro, W.D.; Rodriguez, C.A.; Olinger, C.T.; Cremers, T.L. Los Alamos National Lab., NM (United States). [1993]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930533–7: 15. annual symposium of the European Safeguards Research and Development Association: safeguards and nuclear materials management, Rome (Italy), 11-13 May 1993). Order Number DE93014615. Source: OSTI; NTIS; GPO Dep.

Los Alamos National Laboratory is examining a number of promising technologies that could increase the effectiveness and efficiency of international nuclear safeguards. The techniques described in this paper include video image processing, infrared imaging, and acoustic resonance spectroscopy. Each of these techniques offers unique advantages in the implementation of an inspection regime.

25894 (LA-UR–93-1728) **Recent miniature MCA technology developments at Los Alamos.** Halbig, J.K. (Los Alamos National Lab., NM (United States)); Klosterbuer, S.F.; Russo, P.A.; Sprinkel, J.K.; Stephens, M.M.; Wiig, L.G.; Ianakiev, K.D. Los Alamos National Lab., NM (United States). [1993]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930533–5: 15. annual symposium of the European Safeguards Research and Development Association: safeguards and nuclear materials management, Rome (Italy), 11-13 May 1993). Order Number DE93014578. Source: OSTI; NTIS; GPO Dep.

We have developed a new spectroscopy-grade 4096-channel multichannel analyzer (MCA) for use in the domestic nuclear industry with application in domestic and international nuclear safeguards. It is based on a building-block philosophy (hardware and software). The oversized "blind" prototype for the miniature and modular MCA fits in a box 10 by 20 by 9 cm including bias supply and batteries. Its low power consumption is a third unique feature. Our goal is to provide MCA hardware and software building blocks that people not technically knowledgeable of the internal details can use to build solutions to a wide variety of problems independent of computer platform or operating system.

25895 (LA-UR–93-1818) **Nuclear materials control technology in the post-cold war world: Radiation-based methods and information management systems.** Tape, J.W.; Eccleston, G.W.; Ensslin, N.; Markin, J.T. Los Alamos National Lab., NM (United States). [1993]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930913–2: Global '93: future nuclear systems - emerging fuel cycles and waste disposal options, Seattle, WA (United States), 12-17 Sep 1993). Order Number DE93014556. Source: OSTI; NTIS; INIS; GPO Dep.

The end of the cold war is providing both opportunities and requirements for improving the control of nuclear materials around the world. The dismantlement of nuclear weapons and the growth of nuclear power, including the use of plutonium in light water reactors and breeder reactor programs, coupled with enhanced proliferation concerns, drive the need for improved nuclear materials control. We describe nuclear materials control and the role of technology in making controls more effective and efficient. The current use and anticipated development in selected radiation-based methods and related information management systems am described briefly.

25896 **Integrated optical tamper sensor.** Carson, R.F.; Casalnuovo, S.A. To Dept. of Energy. 1991. Filed date 6 Jun 1991. USA patent application 7-711,235. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93015705. Source: OSTI; NTIS; GPO Dep.

This invention consists of an monolithic optical tamper sensor, comprising an optical emitter and detector, connected by an optical waveguide and placed into the critical entry plane of an enclosed sensitive region, the tamper sensor having a myriad of scraps of a material optically absorbent at the wavelength of interest, such that when the absorbent material is in place on the waveguide, an unique optical signature can be recorded, but when entry is attempted into the enclosed sensitive region, the scraps of absorbent material will be displaced and the optical/electrical signature of the tamper sensor will change and that change can be recorded.

25897 (SAND–92-2782C) **Tactical Automated Security System (TASS).** Christiansen, M.L.; Madsen, R.W.; Gangel, D.J. Sandia National Labs., Albuquerque, NM (United States). [1993]. 15p. Sponsored by USDOE, Washington, DC (United States); Department of Defense, Washington, DC (United States). DOE Contract AC04-76DP00789. MOU DE-AI04-79AL11812. (CONF-9305110–3: Expo 93, Oak Ridge, TN (United States), May 1993). Order Number DE93013762. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The Tactical Automated Security System (TASS) Program is a US Air Force funded program to develop rapidly deployable security systems for tactical, portable, and semipermanent applications. With the changing world military posture of declining manpower, base and asset relocation, and limited funding, the demand for easily transportable and relocatable security systems for asset protection and temporary perimeter security is increasing. This new philosophy of rapid response with relocatable security equipment is not limited to military organizations but spans almost all government and private organizations concerned with remote monitoring of activities or sensitive assets. The experience gained by Sandia National Laboratories in over 30 years of developing and implementing security systems for the protection of nuclear weapons and resources at fixed nuclear facilities is now being applied to the development and application of tactical, portable, and semipermanent security systems. This paper summarizes the objectives, accomplishments, and status of two related Air Force programs: TASS and Relocatable Sensors. The Relocatable Sensors program is a predecessor to, and subset of, TASS and has resulted in the deployment and operation of portable and semipermanent sensor systems at several US Air Force facilities. TASS is a new program that is developing concepts, requirements, and hardware for future rapid deployment security needs within the Air Force and other government agencies. This paper describes the TASS equipment, which includes relocatable sensors, graphics-based and hand-held annunciators, wireless communication links, assessment devices (Closed Circuit Television cameras and thermal imagers), and portable power subsystems. These components and subsystems

are being prototyped and tested and will be integrated into low-cost rapidly deployable TASS security systems to meet the diverse needs of the Air Force and other government organizations.

25898 (SAND–93-0442C) **Sandia Access Delay Technology Program.** Linker, K.L.; Plugge, M.M. Sandia National Labs., Albuquerque, NM (United States). [1993]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9306180–1: 9. annual joint Government-Industry symposium on security technology, Virginia Beach, VA (United States), 21-24 Jun 1993). Order Number DE93015648. Source: OSTI; NTIS; INIS; GPO Dep.

Sandia National Laboratories (SNL) has been involved in security systems development and application for approximately twenty years. This involvement has included the development of physical security system elements such as detection, assessment, access delay, and response. SNL has continued to be very active in access delay design, development, and application including fixed barriers, deployable barriers, and activated dispensables. Access delay is becoming increasingly important in physical security systems designs as threat capabilities increase and security personnel operational costs escalate. SNL is presently developing two access delay systems incorporating multiple access delay features. The first is the Intra- site Secure Transport Vehicle (ISTV) which is being developed to address security and safety vulnerabilities during transportation. The second is a Rapid Deployment Access Delay System (RAPADS) that provides enhanced security for temporary storage or contingency operations. This paper includes a brief history of SNL involvement in access delay hardware development and the basic design features and capabilities of the ISTV and RAPADS.

0560 Legislation and Regulations

Refer also to citation(s) 25655, 25656, 25669, 25676, 25869, 25875, 26213, 26214, 26215, 26424, 27635, 27658

25899 (DOE/CH/10324–T4) **State alternative route designations.** Southern States Energy Board, Norcross, GA (United States). Jul 1989. 55p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC01-87CH10324. Order Number DE93016300. Source: OSTI; NTIS; INIS; GPO Dep.

Pursuant to the Hazardous Materials Transportation Act (HMTA), the Department of Transportation (DOT) has promulgated a comprehensive set of regulations regarding the highway transportation of high-level radioactive materials. These regulations, under HM-164 and HM-164A, establish interstate highways as the preferred routes for the transportation of radioactive materials within and through the states. The regulations also provide a methodology by which a state may select alternative routes. First,the state must establish a "state routing agency," defined as an entity authorized to use the state legal process to impose routing requirements on carriers of radioactive material (49 CFR 171.8). Once identified, the state routing agency must select routes in accordance with Large Quantity Shipments of Radioactive Materials or an equivalent routing analysis. Adjoining states and localities should be consulted on the impact of proposed alternative routes as a prerequisite of final route selection. Lastly, the states must provide written notice of DOT of any alternative route designation before the routes are deemed effective.

25900 (DOE/EH–0323) **RCRA corrective action program guide (Interim).** USDOE Assistant Secretary for Environment, Safety, and Health, Washington, DC (United States). RCRA/CERCLA Div. May 1993. 539p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93015124. Source: OSTI; NTIS; GPO Dep.

The US Department of Energy (DOE) is responsible for compliance with an increasingly complex spectrum of environmental regulations. One of the most complex programs is the corrective action program proposed by the US Environmental Protection Agency (EPA) under the authority of the Resource Conservation and Recovery Act (RCRA) as amended by the Hazardous and Solid Waste Amendments (HSWA). The proposed regulations were published on July 27, 1990. The proposed Subpart S rule creates a comprehensive program for investigating and remediating releases of hazardous wastes and hazardous waste constituents from solid waste management units (SWMUs) at facilities permitted to treat, store, or dispose of hazardous wastes. This proposed rule directly impacts many DOE facilities which conduct such activities. This guidance document explains the entire RCRA Corrective Action process as outlined by the proposed Subpart S rule, and provides guidance intended to assist those persons responsible for implementing RCRA Corrective Action at DOE facilities.

25901 (IAEA-TECDOC–696, pp. 63-66) **Principles of the Codex general standard for irradiated foods and associated code of practice.** Ladomery, L.G. (Joint FAO/IAEA Div. of Nuclear Techniques in Food and Agriculture, Vienna (Austria)). World Health Organization, Manila (Philippines). Regional Office for the Western Pacific; Joint FAO/IAEA Div. of Nuclear Techniques in Food and Agriculture, Vienna (Austria). Mar 1993. (CONF-9201151–: WHO/IAEA/FAO seminar on harmonization of regulations on food irradiation in Asia and the Pacific, Kuala Lumpur (Malaysia), 20-24 Jan 1992). In *Harmonization of regulations on food irradiation in Asia and the Pacific: Proceedings of a seminar held in Kuala Lumpur, Malaysia, 20-24 January 1992.* [211p.] Order Number DE93629035. Source: OSTI; NTIS (US Sales Only); INIS.

The Codex Alimentarius Commission, which is the Executive Organ of the Joint FAO/WHO Food Standards Programme, adopted in 1983 a General Standard for Irradiated Foods and a Recommended International Code of Practice for the Operation of Radiation Facilities used for the Treatment of Foods. The Standard takes into account the conclusions of Joint FAO/IAEA/WHO Expert Committees, convened to evaluate all available data concerning the effects of irradiation treatment on food, including extensive wholesomeness data and animal tests. The Standard represents a set of principles and requirements for the process and for the irradiated product. It does not go into details concerning the application of food irradiation to individual food products on groups of food products in accordance with good irradiation practice. Such details are covered in a special Codes of Good Irradiation Practice elaborated by the FAO/IAEA/WHO International Consultative Group on Food Irradiation. The lecture will describe the various provisions of the Codex Standard for Irradiated Foods and the Code and provide explanation of the intent of these provisions, drawing attention to the actual practices followed by Governments in regulating food irradiation. (author). 12 refs.

25902 (INIS-mf–12758, pp. 499-503) **New regulatory aspects of UF_6 transport.** Biaggio, A.L. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina). Gerencia de Seguridad Radiologica y Nuclear); Lee Gonzales, H.M.; Lopez Vietri, J.R.; Novo, R.G. Asociacion Argentina de Tecnologia Nuclear, Buenos Aires (Argentina). 1987. [735p.] (In Spanish). (CONF-8711355–: 15. scientific meeting and 4th Latin American meeting and 1st sessions on nuclear power plants, San Carlos de Bariloche (Argentina), 2-6 Nov 1987). In *Proceedings of the fifteenth scientific meeting; fourth Latin American meeting; first sessions on nuclear power plants.* Order Number DE91003052. Source: OSTI; NTIS (US Sales Only); INIS.

In nuclear industry, a great amount of uranium is transformed from a chemical form to another. When the fuel cycle requires enrichment, uranium hexafluoride (UF 6) is handled, stored and transported in great quantities. To analyze the risks involved in possible accidents associated with UF_6, radiological and chemical aspects must be considered. So far, the international practice was based on the adoption of regulations from a particular country (ANSI No. 14.1-1982.U.S.A.). In this way, the adoption of these norms at international level is difficult. For that reason, the International Atomic Energy Agency has attempted to consider the chemical risks associated with UF_6 in order to establish a more universal basis ('Recommendations for Providing Protection during the Transport of Uranium Hexafluoride' IAEA-TECDOC-423, Vienna, June 1987 - Austria). A critical analysis of these recommendations is presented in this work. The coherence and the degree of completion of the new recommendations are evaluated and the safety level is compared with that of the accepted regulations for toxic or corrosive substances and for radioactive materials transport. (Author).

25903 (INIS-mf–13543, pp. 33-52) **Anti-radon provisions by Building Offices.** Ondrejechova, V. (Ministerstvo Zivotniho Prostredi CR, Praha (Czechoslovakia)). Ministerstvo Zivotniho Prostredi, Prague (Czech Republic); Okresni Urad, Jihlava (Czech Republic); Dum Kultury Odboru, Jihlava (Czech Republic). 1992. (In Czech). (CONF-9211241–: Conference on provisions against radon, Jihlava (Czech Republic), 23-25 Nov 1992). In *Conference on provisions against radon: Proceedings.* [232p.] Order Number DE93629294. Source: OSTI; NTIS (US Sales Only); INIS.

The Czech Ministry of Finance has issued regulations concerning financial contributions by the government to anti-radon provisions in homes. The Ministry also issued an instruction concerning homes made of building materials for the manufacture of which state enterprises employed power plant slag containing radioactive elements; such homes can be bought out by the state. Building Offices in the Czech Republic are state authorities assessing and issuing permits for the construction, reconstruction or demolition of any building. The responsibilities of the Building Offices in territorial planning, territorial proceedings, building proceedings and approvals, etc., are outlined. An overview of applicable legislation is given. (M.D.).

07 ISOTOPE AND RADIATION SOURCE TECHNOLOGY

0701 Physical Isotope Separation

Refer also to citation(s) 25633, 25634, 26290, 27251, 27252

25904 (CONF-930304–25) **Radioisotope production at Oak Ridge National Laboratory–past, present, and future.** Collins, E.D.; Alexander, C.W.; Bigelow, J.E.; Ottinger, C.L. Oak Ridge National Lab., TN (United States). [1993]. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 205. American Chemical Society national meeting; Denver, CO (United States); 28 Mar - 2 apr 1993. Order Number DE93015438. Source: OSTI; NTIS; GPO Dep.

Radioisotopes of significant value to research, medicine, and industry have been successfully produced at ORNL for many years, using a variety of reactors and hot cell facilities. Plans are for continued production. The ANS and Melton Valley facilities are planned for 21st century operation. Significant issues must be resolved to enable continued operation: stabilized and sufficient funding; appropriate regulation of facility operation and transportation of radioactive materials; and integrated planning and provision for waste treatment, storage, and disposal. 6 figs, 2 tabs.

25905 (DPSP–55-454-4) **Savannah River Plant history, GS Area, July 1954–December 1972.** Du Pont de Nemours (E.I.) and Co., Aiken, SC (United States). Savannah River Plant. Apr 1973. 277p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. (SR/H–530). Order Number DE93012424. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This volume contains a condensed survey of the yearly activities of the GS Area and the various Plant agencies which contributed to its operation. Only salient features of the area's operation are reviewed. Emphasis is placed on results obtained and reasons for actions taken rather than on process detail. The time period covered is July 1954 through December 1972.

25906 (INIS-mf–12758, pp. 461-465) **Operation of plant to produce Mo-99 from fission products.** Marques, R.O. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina). Gerencia de Radioisotopos y Radiaciones); Cristini, P.R.; Marziale, D.P.; Furnari, E.S.; Fernandez, H.O. Asociacion Argentina de Tecnologia Nuclear, Buenos Aires (Argentina). 1987. [735p.] (In Spanish). (CONF-8711355–: 15. scientific meeting and 4th Latin American meeting and 1st sessions on nuclear power plants, San Carlos de Bariloche (Argentina), 2-6 Nov 1987). In *Proceedings of the fifteenth scientific meeting; fourth Latin American meeting; first sessions on nuclear power plants.* Order Number DE91003052. Source: OSTI; NTIS (US Sales Only); INIS.

As it is well known, the production of Mo-99/Tc-99m generators has an outstanding place in radioisotope programs of the Argentine National Atomic Energy Commission. The basic raw material is Mo-99 from fission of U-235. In 1985 the production plant of this radionuclide began to operate, according to an adaptation of the method that was developed in Kernforschungszentrum Karlsruhe. The present work describes the target irradiation conditions in the reactor RA-3 (mini plates of U/Al alloy with 90% enriched uranium), the flow diagram and the operative conditions of the production process. The containment, filtration and removal conditions of the generated fission gases and the disposal of liquid and solid wastes are also analyzed. On the basis of the experience achieved in the development of more than twenty production processes, process efficiency is analyzed, taking into account the theoretical evaluation resulting from the application of the computer program 'Origin'(ORML) to the conditions of our case. The purity characteristics of the final product are reported (Zr-95 0,1 ppm; Nb-95 1 ppm; Ru-103 20 ppm; I-131 10 ppm) as well as the chemical characteristics that make it suitable to be used in the production of Mo-99/I c-99m generators. (Author).

25907 (INIS-mf–12758, pp. 466-470) **Ruthenium-103 and molybdenum-99 impurities in successive elution s of Mo-99Tc-99m generators.** Rotta, M.C. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina). Gerencia de Radioisotopos y Radiaciones); Esposito, M.G.; Viirsoo, M.T. Asociacion Argentina de Tecnologia Nuclear, Buenos Aires (Argentina). 1987. [735p.] (In Spanish). (CONF-8711355–: 15. scientific meeting and 4th Latin American meeting and 1st sessions on nuclear power plants, San Carlos de Bariloche (Argentina), 2-6 Nov 1987). In *Proceedings of the fifteenth scientific meeting; fourth Latin American meeting; first sessions on nuclear power plants.* Order Number DE91003052. Source: OSTI; NTIS (US Sales Only); INIS.

Chromatographic generators of Mo-99/Tc-99m for medical purposes are produced since 1975 by the National Atomic Energy Commission. Mo-99 was obtained as from 1985 through selective separation of fission products. In this way, generators of high specific activity and high activity are obtained. The generator elutions are tested for impurities by routine. The requirements of the National Argentine Pharmacopoeia are fulfilled in all cases. The determination of Mo-99 content is performed in an ionization chamber using for the elution a lead shield 7.5 mm thick. The other nuclides that can be present are analyzed by gamma spectrometry with solid state detector. In order to measure recent elutions a lead shield 5 mm thick is used for the sample to prevent the interference of Tc-99m (140.5 keV). Among the elution impurities, the highest content corresponds to Mo-99 and Ru-103. Its value has been studied by varying the number of elutions extracted from the generator. The elutions from 22 generators of 8 different lots of generators were analyzed. The elution frequency was 1-2 elutions/day. In some cases the follow-up period was 14 days. The determination of Ru-103 (T 1/2 39,26 days) was performed on decayed solutions in order to prevent the interference of Tc-99m (T 1/2 6,00 h) and Mo-99 (T 1/2 66,02 h) during the measurement. In all cases the ratio Mo-99/Tc-99m was almost constant while the values of Ru-103/Tc-99m ratio varied between 0.02 and 1.5 ppm. A progressive decrease was observed during the first week of use and an increase during the second week because the total activity of Ru-103 tends to be constant while that of Tc-99m decays. (Author).

25908 (SR/H–573) **Dana history start-up through December 31, 1952.** [Plant Histories]. Du Pont de Nemours (E.I.) and Co., Aiken, SC (United States). Savannah River Plant. [1952]. 102p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. Order Number DE93015170. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The purpose of this report is to present an overall picture of DuPont's management of the Dana Plant. The period covered by this initial section ends December 31, 1952; continued work will be covered by additional sections issued on a year to year basis.

25909 (UCRL-JC–109276) **Design and performance of an automated video-based laser beam alignment system.** Rundle, W.J. (Martin Marietta Energy Systems, Inc., Oak Ridge, TN (United States)); Kartz, M.W.; Bliss, E.S.; English, R.E. Jr.; Peterson, R.L.; Thompson, G.R.; Uhlich, D.M. Lawrence Livermore National Lab., CA (United States). 14 Jul 1992. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48.

(CONF-920792–57: Society of Photo-Optical Instrumentation Engineers (SPIE) international symposium on optical applied science and engineering, San Diego, CA (United States), 19-24 Jul 1992). Order Number DE93012571. Source: OSTI; NTIS; GPO Dep.

This paper describes the design and performance of an automated, closed-loop, laser beam alignment system. Its function is to sense a beam alignment error in a laser beam transport system and automatically steer mirrors preceding the sensor location as required to maintain beam alignment. The laser beam is sampled by an optomechanical package which uses video cameras to sense pointing and centering errors. The camera outputs are fed to an image processing module, which includes video digitizers and uses image storage and software to sense the centroid of the image. Signals are sent through a VMEbus to an "optical device controller" (ODC), which drives stepper-motor actuators on mirror mounts preceding the beam-sampling location to return the beam alignment to the prescribed condition. Photodiodes are also used to extend the control bandwidth beyond that which is achievable with video cameras. This system has been operated at LLNL in the Atomic Vapor Laser Isotope Separation (AVLIS) program to maintain the alignment of copper and dye laser beams, the latter to within ± 2 μr in pointing and less than 1 mm in centering. The optomechanical design of the instrumented package, which includes lens, mirror, and video mounts in a rigid housing, the automated control system architecture, and the performance of this equipment is described.

25910 (UCRL-JC–110875) **Design of a formaldehyde photodissociation process for carbon and oxygen isotope separation.** Stern, R.C.; Scheibner, K.F. Lawrence Livermore National Lab., CA (United States). 20 Jan 1993. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-930159–40: OE/LASE '93: International Society for Optical Engineering (SPIE) conference, Los Angeles, CA (United States), 16-23 Jan 1993). Order Number DE93016435. Source: OSTI; NTIS; INIS; GPO Dep.

The current shortage of ^{18}O has revived interest in using one step UV photodissociation of formaldehyde to enrich ^{13}C, ^{17}O and ^{18}O. The frequency doubled output of the copper laser pumped dye laser system currently in operation at LLNL can be used to drive this dissociation. The authors use a simple kinetics model and their experience with Atomic Vapor Laser Isotope Separation (AVLIS) process design to examine the relative merits of different designs for a formaldehyde photodissociation process. Given values for the molecular photoabsorption cross section, partition function, spectroscopic selectivity, collisional exchange and quenching cross sections (all as parameters), they perform a partial optimization in the space of illuminated area, formaldehyde pressure in each stage, and formaldehyde residence time in each stage. They examine the effect of cascade design (heads and tails staging) on molecule and photon utilization for each of the three isotope separation missions, and look in one case at the system's response to different ratios of laser to formaldehyde costs. Finally, they examine the relative cost of enrichment as a function of isotope and product assay. Emphasis is as much on the process design methodology, which is general, as on the specific application to formaldehyde.

25911 (UCRL-JC–111091) **Status of gadolinium enrichment technology at LLNL.** Haynam, C.; Comaskey, B.; Conway, J.; Eggert, J.; Glaser, J.; Ng, E.; Paisner, J.; Solarz, R.; Worden, E. Lawrence Livermore National Lab., CA (United States). Jan 1993. 28p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-930159–33: OE/LASE '93: International Society for Optical Engineering (SPIE) conference, Los Angeles, CA (United States), 16-23 Jan 1993). Order Number DE93014416. Source: OSTI; NTIS; GPO Dep.

A method based on,polarization selectivity and three step laser photoionization is presented for separation of the odd isotopes of gadolinium. Measurements of the spectroscopic parameters needed to quantify the excitation pathway are discussed. Model results are presented for the efficiency of photoionization. The vapor properties of electron beam vaporized gadolinium are presented which show dramatic cooling during the expansion of the hot dense vapor into a vacuum. This results in a significant increase in the efficiency of conversion of natural feed into enriched product in the AVLIS process. Production of enriched gadolinium for use in commercial power reactors appears to be economically viable using technology in use at LLNL.

25912 (WSRC-TR–92-552) **Materials performance in prototype Thermal Cycling Absorption Process (TCAP) columns.** Clark, E.A. Westinghouse Savannah River Co., Aiken, SC (United States). 21 Nov 1992. 22p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93014722. Source: OSTI; NTIS; INIS; GPO Dep.

Two prototype Thermal Cycling Absorption Process (TCAP) columns have been metallurgically examined after retirement, to determine the causes of failure and to evaluate the performance of the column container materials in this application. Leaking of the fluid heating and cooling subsystems caused retirement of both TCAP columns, not leaking of the main hydrogen-containing column. The aluminum block design TCAP column (AHL block TCAP) used in the Advanced Hydride Laboratory, Building 773-A, failed in one nitrogen inlet tube that was crimped during fabrication, which lead to fatigue crack growth in the tube and subsequent leaking of nitrogen from this tube. The Third Generation stainless steel design TCAP column (Third generation TCAP), operated in 773-A room C-061, failed in a braze joint between the freon heating and cooling tubes (made of copper) and the main stainless steel column. In both cases, stresses from thermal cycling and local constraint likely caused the nucleation and growth of fatigue cracks. No materials compatibility problems between palladium coated kieselguhr (the material contained in the TCAP column) and either aluminum or stainless steel column materials were observed. The aluminum-stainless steel transition junction appeared to be unaffected by service in the AHL block TCAP. Also, no evidence of cracking was observed in the AHL block TCAP in a location expected to experience the highest thermal shock fatigue in this design. It is important to limit thermal stresses caused by constraint in hydride systems designed to work by temperature variation, such as hydride storage beds and TCAP columns.

0702 Radiation Sources

Refer also to citation(s) 26724, 27046, 27201

25913 (DOE/FTR–93012812) **[Travel to 8th international conference on ion beam modification of materials to present one unclassified paper and attend conference sessions]: Foreign trip report, September 5–12, 1992.** Weber, W.J. Pacific Northwest Lab., Richland, WA (United States). 29 Sep 1992. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93012812. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The conference highlighted the high-level of international research effort on ion-beam modification and processing of semiconductors, metals, intermetallics, ceramics, glasses, polymers, and high- temperature superconductors. There were 470 participants from 34 different countries. Although both basic and applied research were covered, it is clear that most current efforts are applications oriented.

25914 (ENEA-RT-INN–92-38) **Irradiation technology for cosmetics hygienization.** Adamo, M.; Musciagna, A. ENEA, Casaccia (Italy). Area Energia e Innovazione. Dec 1992. 86p. (In Italian). (RT/INN–92-38). Order Number DE93799288. Source: OSTI; NTIS (US Sales Only); INIS.

Italy occupies a leading position in the international cosmetics market; in 1990, sector sales were about $ 4 billion. The possible microbiological contamination of a cosmetics product can be due both to raw materials, which present usually a remarkable microbic load, and manufacturing process anomalies. Microbiological contamination can cause both skin pathologies and product spoilage. Preserving substances are used in order to prevent cosmetics microbiological contamination; however, these substances are not devoid of toxicological risk and can cause phenomena of skin sensitization. Irradiation technologies allow manufacturers to brilliantly resolve the problem of cosmetic products hygienization by a very effective, homogeneous treatment process, which is, moreover, exactly reproducible and easily controllable. These technologies, with the observance of good manufacturing practise and the execution

of checks, which are provided for in Italian and European legislation, in conformity with good manufacturing quality, allow manufacturers to achieve a cosmetics product of excellent quality.

25915 (LA-UR–93-1716) **Real-time spot size camera for pulsed high-energy radiographic machines.** Watson, S.A. Los Alamos National Lab., NM (United States). [1993]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930511–110: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014583. Source: OSTI; NTIS; INIS; GPO Dep.

The focal spot size of an x-ray source is a critical parameter which degrades resolution in a flash radiograph. For best results, a small round focal spot is required. Therefore, a fast and accurate measurement of the spot size is highly desirable to facilitate machine tuning. This paper describes two systems developed for Los Alamos National Laboratory's Pulsed High-Energy Radiographic Machine Emitting X-rays (PHERMEX) facility. The first uses a CCD camera combined with high-brightness floors, while the second utilizes phosphor storage screens. Other techniques typically record only the line spread function on radiographic film, while systems in this paper measure the more general two-dimensional point-spread function and associated modulation transfer function in real time for shot-to-shot comparison.

25916 (LA-UR–93-1878) **A Los Alamos design study for a high-power spallation-neutron-source driver.** Jason, A.J.; Hardekopf, R.A.; Macek, R.W.; Schriber, S.O.; Thiessen, H.A.; Woods, R. Los Alamos National Lab., NM (United States). [1993]. 4p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930511–116: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014472. Source: OSTI; NTIS; GPO Dep.

A design study for an accelerator-driven spallation-neutron source is underway at Los Alamos. The driver, based on the LAMPF facility, produces a 1-MW proton beam and is upgradable to 5 MW. After linear acceleration to full energy, an H-beam is accumulated for approximately I ms in a compressor ring and then extracted to produce an intense proton burst, less than 1 μs long, onto a spallation target system with a 60-Hz cycle rate. The design uses existing infrastructure insofar as possible while maintaining project goals. This paper summarizes the system specifications and design status.

25917 (LA-UR–93-1897) **Linac design study for an intense neutron-source driver.** Lynch, M.T.; Browman, A.; DeHaven, R.; Jameson, R.; Jason, A.; Neuschaefer, G.; Tallerico, P.; Regan, A. Los Alamos National Lab., NM (United States). [1993]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930511–113: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014465. Source: OSTI; NTIS; INIS; GPO Dep.

The 1-MW spallation-neutron source under design study at Los Alamos is driven by a linac-compressor-ring scheme that utilizes a large portion of the existing Los Alamos Meson Physics Facility (LAMPF) linac, as well as the facility infrastructure. The project is referred to as the National Center for Neutron Research (NCNR). A second phase of the proposal will upgrade the driver power to 5 MW. A description of the 1-MW scheme is given in this paper. In addition, the upgrade path to the substantial increase of beam power required for the 5 MW scenario is discussed.

25918 (LRP–472/93) **Negative hydrogenated silicon ion clusters as particle precursors in RF silane plasma deposition experiments.** Howling, A.A. (Ecole Polytechnique Federale, Lausanne (Switzerland). Centre de Recherche en Physique des Plasma (CRPP)); Sansonnens, L.; Dorier, J.L.; Hollenstein, C. Ecole Polytechnique Federale, Lausanne (Switzerland). Centre de Recherche en Physique des Plasma (CRPP). Mar 1993. [12p.] Order Number DE93629552. Source: OSTI; NTIS; INIS.

Stable negative ions containing up to sixteen silicon atoms have been measured by mass spectrometry in rf power-modulated silane plasmas for amorphous silicon deposition. These hydrogenated silicon cluster ions reach much higher masses than the positive ions, which have no more than six silicon atoms. This supports the view that negative ions are the precursors to particulate formation in silane plasmas. The time-dependent fluxes of positive and negative ions from the plasma are shown with a 5 μs time resolution. Possible cluster reaction sequences are discussed, and the effect of visible light on the negative ion signal is commented upon. (author) 3 figs., 24 refs.

25919 (OEFZS–4673) **Response of soil aggregate stability to storage time of soil samples.** Gerzabek, M.H. (Hauptabteilung Agrarforschung und Biotechnologie, Forschungszentrum Seibersdorf GmbH, Seibersdorf (Austria)); Roessner, H. Oesterreichisches Forschungszentrum Seibersdorf GmbH (Austria). Apr 1993. [8p.] (In German). Order Number DE93628203. Source: OSTI; NTIS (US Sales Only); INIS.

Reprint from Die Bodenkultur, Journal fuer landwirtschaftliche Forschung v. 44(1), Feb 1993.

The aim of the present study was to investigate the well known phenomenon of changing aggregate stability values as result of soil sample storage. In order to evaluate the impact of soil microbial activity, the soil sample was split into three subsamples. Two samples were sterilized by means of chloroform fumigation and gamma irradiation, respectively. However, the aggregate stability measurements at three different dates were not correlated with the microbial activity (dehydrogenase activity). The moisture content of the aggregate samples seems to be of higher significance. Samples with lower moisture content (range: 0.4 to 1.9%) exhibited higher aggregate stabilities. Thus, airdried aggregate samples without further treatment don't seem to be suitable for standardized stability measurements. (authors).

25920 (ORNL/FTR–4574) **[Travel to Japan to attend the fifth international symposium on advanced nuclear energy research and to visit the new research reactor JRR-3M]: Foreign trip report, March 9–12, 1993.** Hayter, J.B. Oak Ridge National Lab., TN (United States). 29 Mar 1993. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93011816. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The Fifth International Symposium on Advanced Nuclear Energy Research was cosponsored by seven major Japanese professional Institutes and Societies. The symposium was subtitled "Neutrons as Microscopic Probes". It was based on twenty invited lectures from a group of international experts, covering most current uses of neutron research, and was followed by a round table discussion of future trends. The symposium, with about 350 attendees, was clearly intended to foster Japanese use of neutrons by academic, industrial, and government scientists and engineers. I was invited to lecture in "New Techniques on Neutron Scattering" and to be a panel member for the round table on "Future Research with Neutrons". There is intense interest in the Advanced Neutron Source (ANS) project and several officials of the Japan Atomic Energy Research Institute (JAERI) expressed interest in expanding their collaboration in the project. After the symposium I was able to visit the most modern Japanese neutron beam research reactor at the JAERI Tokai Research Establishment.

0703 Isotopic Power Supplies

25921 (DOE/NE/32140–22) **Follow-up investigations of GPHS motion during heat pulse intervals of reentries from gravity-assist trajectories: Aerospace Nuclear Safety Program.** Sharbaugh, R.C. Johns Hopkins Univ., Laurel, MD (United States). Applied Physics Lab. 23 Mar 1992. 274p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AI01-88NE32140. (JHU/APL-ANSP-M–22). Order Number DE93013816. Source: OSTI; NTIS; INIS; GPO Dep.

Motion studies of the General Purpose Heat Source Module, GPHS, which were conducted in the heat pulse intervals associated with entries from earth gravity assist trajectories. The APL six-degree-of-freedom reentry program designated TMAGRA6C was used. The objectives of the studies were to (1) determine whether the GPHS module entering the earth's atmosphere from

an earth-gravity-assist trajectory has a preferred orientation during the heat pulse of reentry, (2) determine the effect of magnus force on the roll rate and angle of attack of the GPHS during an EGA entry, (3) determine the effect of the magnitude of pitch and roll damping on the GPHS motion.

0704 Economic, Industrial, and Business Aspects

Refer also to citation(s) 27046

0705 Health and Safety

Refer also to citation(s) 27610, 27658

25922 (DOE/SR/18217–2) **Cancer and birth defects surveillance system for communities around the Savannah River Site: Annual progress report.** Dunbar, J.B. Medical Univ. of South Carolina, Charleston, SC (United States). Dept. of Biostatistics, Epidemiology, and System Sciences. May 1993. 157p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG09-91SR18217. Order Number DE93015421. Source: OSTI; NTIS; GPO Dep.

This technical report presents the age-adjusted total, and race and sex specific geographic patterns of cancer mortality for South Carolina (SC) counties utilizing the 1953–1987 average annual age-adjusted mortality rates (AAMRs). The mortality information was obtained from the State Cancer Control Map and Data Program produced by the National Cancer Institute , Centers for Disease Control and the American Cancer Society. The AAMRs for selected primary sites are classified as significantly different or not significantly different from the corresponding United States and SC mortality rates. Categories for classification of the rates are determined using 95% confidence intervals. Geographic patterns of significantly high county AAMRs are identified and discussed. Individual county rates are not emphasized. The terminology, mortality rates used throughout this report pertains to the 1953–1987 AAMRS.

0706 Environmental Aspects

25923 (IAEA-TECDOC–696, pp. 83-88) **Environmental impact assessment in the establishment of food irradiation facilities.** Roberts, P. (DSIR Physical Sciences, Lower Hutt (New Zealand). Nuclear Sciences Group). World Health Organization, Manila (Philippines). Regional Office for the Western Pacific; Joint FAO/IAEA Div. of Nuclear Techniques in Food and Agriculture, Vienna (Austria). Mar 1993. (CONF-9201151–: WHO/IAEA/FAO seminar on harmonization of regulations on food irradiation in Asia and the Pacific, Kuala Lumpur (Malaysia), 20-24 Jan 1992). In *Harmonization of regulations on food irradiation in Asia and the Pacific: Proceedings of a seminar held in Kuala Lumpur, Malaysia, 20-24 January 1992.* [211p.] Order Number DE93629035. Source: OSTI; NTIS (US Sales Only); INIS.

Many commercial food irradiation facilities use cobalt-60 as a source of gamma radiation. This article describes the manufacture and physical characteristics of cobalt-60 sources, and outlines the basic operation of cobalt-60 facilities. In routine use the environmental impact of such a plant is negligible. A series of potential accident scenarios is discussed, leading to the conclusion that cobalt-60 irradiation should be regarded as a very safe industrial activity.

08 HYDROGEN

25924 (NEI-DK–1182) **Hydroelectric-power/hydrogen systems in Greenland: Pre-feasibility study of hydrogen as energy carrier for hydroelectric power.** Groenlands Energiforsyning, Copenhagen (Denmark). May 1993. 65p. (In Danish). Conctract ENS-1443/91-0008. Order Number DE93500121. Source: OSTI; NTIS.

EFP-91.

The aim was to investigate whether energy from one large hydroelectric power station could be used in several towns in Greenland by using hydrogen as a medium for energy storage so that this energy could be transported by sea. Other means of transport in Greenland would be very costly and are often technologically impossible. The primary idea was to establish a hydrogen-producing plant in the town of Nuuk on the basis of electricity from a hydroelectric power plant in Buksefjorden and the use of the hydrogen in power and heating plants in a number of towns on the west coast. The production of hydrogen would take place by the use of alkaline water electrolysis and the hydrogen would be stored and transported in liquid form. This involves cooling the hydrogen down to -235 degrees centigrade. Transport and storage would take place in highly insulated standard sized containers. A system analysis was carried out where hydrogen is illustrated as an alternative fuel to oil. It was concluded that it is technologically possible to introduce hydrogen as an energy carrier within the Greenlandic energy system. Hydrogen produced in connection with hydroelectric power is an environmentally-protective alternative to oil, but cannot compete economically, it would cost about five times as much. But hydrogen is interesting in the light of possible future export and as a medium for promoting greater use of Greenland's vast hydroelectric power potentials. (AB).

0801 Production

Refer also to citation(s) 25500, 25502, 25506, 25926

25925 (DOE/METC–92/6128-Vol.2, pp. 524-534) **Biological production of hydrogen.** Ko, Ching W. (Engineering Resources, Inc., Fayetteville, AR (US)). USDOE Morgantown Energy Technology Center, WV (United States). Sep 1992. (CONF-920951–Vol.2: 12. annual gasification and gas stream cleanup systems contractors review meeting, Morgantown, WV (United States), 15-17 Sep 1992). In *Proceedings of the twelfth annual gasification and gas stream cleanup systems contractors review meeting: Volume 2.* 314p. Order Number DE93000229. Source: OSTI; NTIS.

The technical and economic feasibility of biological water gas shift has been demonstrated during Phase I of the research program. Extended research is being conducted in Phase II to reduce the technology to practice. Phase II objectives include screening all available cultures for their ability to biocatalyze water gas shift, optimization of the chosen culture for growth and H_2 production, evaluation of the culture in various continuous reactors, evaluation of the suitability of advanced fermentation concepts including high pressure operation and non-aqueous phase fermentation, and process design and economic evaluations.

0802 Storage, Transport, and Handling

Refer also to citation(s) 25926, 26362, 26883

0804 Economic, Industrial, and Business Aspects

25926 (ETDE/JP-mf–93798908) **Prospect on new energies.: Hydrogen energy.** Institute of Applied Energy, Tokyo (Japan). Mar 1992. 30p. (In Japanese). Order Number DE93798908. Source: OSTI; NTIS; Available from The Institute of Applied Energy, 14-2, Nishishinbashi 1-chome, Minato-ku, Tokyo, Japan.

This paper reports surveys on hydrogen energy carried out by the General Energy Engineering Research Institute of Japan. Hydrogen energy is expected of being used for dealing with the global warming problem. The worldwide annual hydrogen demand was 238 billion Nm^3 in 1991 consumed in Oil refining and other utilizing areas, of which about 10% is accounted for by the Japanese demand. Using natural gas as a raw material is a practical way of manufacturing this clean energy in industrial scales. However, it is not desirable that the manufacturing process produces CO2. Hydrogen manufacturing methods are various, including partial oxidation, coal gasification, steam-iron reaction, salt electrolysis, by-production in oil refining, and methanol reformation. Future interest is addressed to water electrolysis which does not depend on fossil fuels. One of the problems in developing hydrogen fueled vehicles is in a simple liquid hydrogen filling device which may need measures to handle NOx generation. Solar beam power generation would be used in much larger scales in the 21st century,

where a conceivable problem will be means for temporary storage and transportation of the energy. 3 refs., 2 figs., 4 tabs.

09 BIOMASS FUELS

Refer also to citation(s) 26440

0907 Resources

Refer also to citation(s) 25969, 27315, 27541

25927 (DOE/OR/21822–1) **Regional assessment of nonforestry related biomass resources: Alabama.** JAYCOR, Vienna, VA (United States). Nov 1988. 191p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AI05-88OR21822. Order Number DE93016386. Source: OSTI; NTIS; GPO Dep.

This document is a collection of spreadsheets detailing on a county by county basis the agricultural crop, agricultural wastes, municipal wastes and industrial wastes of Alabama that are potential biomass energy sources.

25928 (DOE/OR/21822–2) **Regional assessment of nonforestry related biomass resources: Arkansas.** JAYCOR, Vienna, VA (United States). Nov 1988. 175p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AI05-88OR21822. Order Number DE93016387. Source: OSTI; NTIS; GPO Dep.

This document consists of spreadsheets detailing in a county by county manner agricultural crop, agricultural waste, municipal waste and industrial waste in Arkansas that are potential biomass energy sources.

25929 (DOE/OR/21822–3) **Regional assessment of nonforestry related biomass resources: Florida.** JAYCOR, Vienna, VA (United States). Nov 1988. 83p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AI05-88OR21822. Order Number DE93016388. Source: OSTI; NTIS; GPO Dep.

This document is a collection of spreadsheets detailing in a county by county manner the agricultural crop, agricultural wastes, municipal wastes and industrial wastes in Florida that are potential biomass energy sources.

25930 (DOE/OR/21822–4) **Regional assessment of nonforestry related biomass resources: Georgia.** JAYCOR, Vienna, VA (United States). Nov 1988. 323p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AI05-88OR21822. Order Number DE93016389. Source: OSTI; NTIS; GPO Dep.

This document is a collection of spreadsheets detailing in a county by county manner the agricultural crop, agricultural wastes, municipal wastes, and industrial wastes in Georgia that are potential biomass energy sources.

25931 (DOE/OR/21822–5) **Regional assessment of nonforestry related biomass resources: Kentucky.** JAYCOR, Vienna, VA (United States). Nov 1988. 249p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AI05-88OR21822. Order Number DE93016390. Source: OSTI; NTIS; GPO Dep.

This document consists of spreadsheets detailing in a county by county manner the agricultural crop, agricultural wastes, municipal wastes and industrial wastes of Kentucky that are potential biomass energy sources.

25932 (DOE/OR/21822–6) **Regional assessment of nonforestry related biomass resources: Louisiana.** JAYCOR, Vienna, VA (United States). Nov 1988. 151p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AI05-88OR21822. Order Number DE93016391. Source: OSTI; NTIS; GPO Dep.

This document consists of spreadsheets detailing in a county by county manner agricultural crops, agricultural wastes, municipal wastes and industrial wastes of Louisiana that are potential biomass energy sources.

25933 (DOE/OR/21822–7) **Regional assessment of nonforestry related biomass resources: Missouri.** JAYCOR, Vienna, VA (United States). Nov 1988. 252p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AI05-88OR21822. Order Number DE93016392. Source: OSTI; NTIS; GPO Dep.

This document is a collection of spreadsheets detailing in a county by county manner the agricultural crop, agricultural wastes, municipal waste and industrial wastes of Missouri that are potential biomass energy resources.

25934 (DOE/OR/21822–8) **Regional assessment of nonforestry related biomass resources: Mississippi.** JAYCOR, Vienna, VA (United States). Nov 1988. 165p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AI05-88OR21822. Order Number DE93016393. Source: OSTI; NTIS; GPO Dep.

This document is a collection of spreadsheets detailing on a county by county basis the agricultural crop, agricultural wastes, municipal wastes, and industrial wastes of Mississippi that are potential biomass energy sources.

25935 (DOE/OR/21822–9) **Regional assessment of nonforestry related biomass resources: North Carolina.** JAYCOR, Vienna, VA (United States). Nov 1988. 294p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AI05-88OR21822. Order Number DE93016394. Source: OSTI; NTIS; GPO Dep.

This document is a collection of spreadsheets detailing in a county by county manner the agricultural crop, agricultural wastes, municipal wastes and industrial wastes of North Carolina that are potential biomass energy sources.

25936 (DOE/OR/21822–10) **Regional assessment of nonforestry related biomass resources: South Carolina.** JAYCOR, Vienna, VA (United States). Nov 1988. 115p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AI05-88OR21822. Order Number DE93016395. Source: OSTI; NTIS; GPO Dep.

This document is a collection of spreadsheets detailing in a county by county manner the agricultural crop, agricultural wastes, municipal wastes, and industrial wastes of South Carolina that are potential biomass energy sources.

25937 (DOE/OR/21822–11) **Regional assessment of nonforestry related biomass resources: Tennessee.** JAYCOR, Vienna, VA (United States). Nov 1988. 217p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AI05-88OR21822. Order Number DE93016396. Source: OSTI; NTIS; GPO Dep.

This document is a collection of spreadsheets detailing on a county by county basis the agricultural crop, agricultural wastes, municipal wastes, and industrial wastes of Tennessee that are potential biomass energy sources.

25938 (DOE/OR/21822–12) **Regional assessment of nonforestry related biomass resources: Virginia.** JAYCOR, Vienna, VA (United States). Nov 1988. 261p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AI05-88OR21822. Order Number DE93016397. Source: OSTI; NTIS; GPO Dep.

This document is a collection of spreadsheets detailing on a county by county basis the agricultural crop, agricultural wastes, municipal wastes, and industrial wastes of Virginia that are potential biomass energy sources.

25939 (DOE/OR/21822–13) **Regional assessment of nonforestry related biomass resources: West Virginia.** JAYCOR, Vienna, VA (United States). Nov 1988. 139p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AI05-88OR21822. Order Number DE93016398. Source: OSTI; NTIS; GPO Dep.

This document is a collection of spreadsheets detailing on a county by county basis the agricultural crop, agricultural wastes, municipal wastes, and industrial wastes of West Virginia that are potential biomass energy sources.

25940 (DOE/OR/21822–T1) **Regional assessment of nonforestry-related biomass resources.** JAYCOR, Vienna, VA (United States). 1 Dec 1989. 186p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AI05-88OR21822.

Contract TY73501A. Order Number DE93016385. Source: OSTI; NTIS; GPO Dep.

The southeastern region of the United States can produce approximately the annual equivalent of 897 trillion Btu of energy from nonforestry wastes such as agriculture crop residues, animal excreta from confined feedlots, craps that could be grown on agricultural set-aside land, municipal solid wastes, and sewage sludge. This study developed county-level data for these resources.

25941 (VF-UB–93-9) **Biomass production in poplar plantations.** Telenius, B. (Swedish Univ. of Agricultural Sciences, Uppsala (Sweden). Dept. of Ecology and Environmental Research); Elowson, S.; Christersson, L. Vattenfall AB, Vaellingby (Sweden). Mar 1993. 34 p.p. (In Swedish). Order Number DE93500939. Source: OSTI; NTIS.

The changes being made in Swedish agriculture today, from grain production to other forms of production, are the most comprehensive since the great land reform of the 18th century. So far, abandoned arable land has largely been planted with conifers. Timber quality in these types of plantations is poor, with shakes and rot. Most broadleaf trees worth growing, on the other hand, prefer to grow on good land such as the agricultural land now threatened with abandonment. They also have a positive influence on the soil through improving its level of fertility. Species within the poplar family that have attracted most interest are Populus alba, P. nigra, P. tremula, P. tremuloides, P. trichocarpa, P. balsamifera and P. deltoides, and to an even greater extent, hybrides between these species. The first three species are of Eurasian origin, whereas the four latter comes from North America. In earlier plantations with aspen and poplar the stem biomass production varied between 15 and 25 m^3 per hectare and year. A realistic assessment is that production can soon be increased by 20 %. (47 refs.).

0908 Production

Refer also to citation(s) 25970, 27540

25942 (CONF-9005443–) **Eighth international congress on nitrogen fixation: Final program.** Tennessee Univ., Knoxville, TN (United States). [1990]. 279p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-90ER20005. From 8. international congress on nitrogen fixation; Knoxville, TN (United States); 20 May 1990. Order Number DE93015341. Source: OSTI; NTIS; GPO Dep.

This volume contains the proceedings of the Eighth International Congress on Nitrogen Fixation held May 20–26, 1990 in Knoxville, Tennessee. The volume contains abstracts of individual presentations. Sessions were entitled Recent Advances in the Chemistry of Nitrogen Fixation, Plant-microbe Interactions, Limiting Factors of Nitrogen Fixation, Nitrogen Fixation and the Environment, Bacterial Systems, Nitrogen Fixation in Agriculture and Industry, Plant Function, and Nitrogen Fixation and Evolution.

25943 (DOE/METC–92/6128-Vol.2, pp. 535-549) **Development of biological coal gasification (MicGAS process).** Srivastava, K.C. (ARCTECH, Inc., Chantilly, VA (US)); Barik, S. USDOE Morgantown Energy Technology Center, WV (United States). Sep 1992. (CONF-920951–Vol.2: 12. annual gasification and gas stream cleanup systems contractors review meeting, Morgantown, WV (United States), 15-17 Sep 1992). In *Proceedings of the twelfth annual gasification and gas stream cleanup systems contractors review meeting: Volume 2.* 314p. Order Number DE93000229. Source: OSTI; NTIS.

The objectives of the research during FY 1991-92 were to: (1) determine the principal groups of microorganisms that carry out the direct biomethanation of low rank coals, especially lignites, (2) determine the initial kinetics of methane production from coal by the identified microorganisms, (3) enhance methane production using conventional microbiological techniques, (4) develop a low cost medium, and (5) conduct a preliminary assessment of bioreactor types that could be used for scaled-up production of methane in the laboratory.

25944 (ORNL/Sub–85-27413/7) **Perennial species for optimum production of herbaceous biomass in the Piedmont (Management study, 1987–1991): Final report.** Parrish, D.J. (Virginia Polytechnic Inst. and State Univ., Blacksburg, VA (US). Dept. of Crop and Soil Environmental Sciences); Wolf, D.D.; Daniels, W.L. Oak Ridge National Lab., TN (United States); Virginia Polytechnic Inst. and State Univ., Blacksburg, VA (United States). Dept. of Crop and Soil Environmental Sciences. Apr 1993. 42p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93015359. Source: OSTI; NTIS; GPO Dep.

The authors have investigated cutting and N management strategies for two biofuel feedstock candidate species – switchgrass (Panicum virgatum) and weeping lovegrass (Eragrostis curvula). Each was no-till planted in 1987 at three sites underlain by Davidson or Cecil soils. Three N levels (0, 50, or 100 kg/ha) were applied, and the plots fertilized at each level were harvested either twice (early-September and early-November) or only in early-November. The results with lovegrass suggest 50 kg N/ha is nearly optimal and that two cuttings provide more biomass than one. For switchgrass, when averaged across sites and years, 50 kg N/ha produced a slight yield advantage over no added N, but 50 kg was not different from 100 kg. In 1989 and 1990, more biomass was available in early-September harvests (9.6 Mg/ha) than in early-November (8.3 Mg/ha). Apparently the plants translocated significant portions of their biomass below ground during the last few weeks of the season. In 1991, we harvested only in early-November. Plots that had been cut in early-September in the previous three years had lower yields (7.6 Mg/ha) than those that had been cut only in early-November (9.4 Mg/ha). The delayed cutting permitted more growth on a sustained basis – presumably because of conservation of translocatable materials. This poses an interesting dilemma for the producer of biomass. In additional studies, the authors found no advantage in double-cropping rye (Secale cereale) with switchgrass; at low input levels, rye yields were low, and rye lowered switchgrass yields. Other studies showed double-cropping with winter-annual legumes such as crimson clover (Trifolium incarnatum) may have potential. The timing of herbicide treatment of the legume is critical.

25945 (SLU-SKOPRO-R–33) **Forest energy production from conventional forestry systems on a small scale.** Johansson, Tord (ed.). Swedish Univ. of Agricultural Sciences, Garpenberg (Sweden). Dept. of Forest Yield Research. 1992. 35p. (CONF-920003–: 1992 IEA workshop, Garpenberg (Sweden), 1992). Order Number DE93500891. Source: OSTI; NTIS.

Today, forest biomass used as fuelwood increase throughout the world. Different harvesting systems are available. Strong efforts on developing cheap and efficient machines are made. Mostly, fuelwood is harvested in thinning stands or at clear felled areas. In some cases, naturally regenerated forest on farmland managed as a source for biomass production is used for fuelwood. Fuelwood production is often managed by private owners with small areas and on a small scale. Different approaches to solve the harvesting and transporting problem in the view of small scale operation is presented. The effects of different kinds of biomass utilization on the economical and practical impacts are studied. The subject of this workshop, to show the possibilities of forest energy production on a small scale, is essential with the increasing interest by forest owners and the society. Five contributions from Canada, England, Sweden and Switzerland are separately indexed.

25946 (SLU-SKOPRO-R–33, pp. 3-5) **The farm wood fuel and energy project: A new Department of Trade and Industry initiative to stimulate the production and use of wood as a fuel.** Booth, T.C. (Renewable Energy Enquiries Bureau, ETSU, Harwell (United Kingdom)). Swedish Univ. of Agricultural Sciences, Garpenberg (Sweden). Dept. of Forest Yield Research. 1992. (CONF-920003–: 1992 IEA workshop, Garpenberg (Sweden), 1992). In *Forest energy production from conventional forestry systems on a small scale.* 35p. Order Number DE93500891. Source: OSTI; NTIS.

The british project for promoting short rotation cultivation is briefly described. Five farms will serve as demonstration and technique development centres and initiate the creation of a wood fuel market. Through involvement of other local farmers it is hoped that the centres will help to spread the silviculture in their area.

25947 (SLU-SKOPRO-R–33, pp. 7-15) **Fuelwood production in Prince Edward Island.** McCallum, B. (Ensight consulting, Prince Edward Island (Canada)). Swedish Univ. of Agricultural Sciences, Garpenberg (Sweden). Dept. of Forest Yield Research. 1992. (CONF-920003–: 1992 IEA workshop, Garpenberg (Sweden), 1992). In *Forest energy production from conventional forestry systems on a small scale*. 35p. Order Number DE93500891. Source: OSTI; NTIS.

The most recent Prince Edward Island Fuelwood Survey occurred in 1990-91. Consumption of fuelwood rose again to 49% of Prince Edward Island's 43,170 households. Total residential fuelwood consumption was estimated to be 242,000 m^3. The fuelwood industry makes an important contribution to the economy of Prince Edward Island. In the 1990-91 heating season, fuelwood valued at USD 9 million displaced approximately 43 million litres of domestic heating oil valued at USD 16.4 million. In addition, it is estimated that 70 cents of every dollar spent on fuelwood remains in the province and contributes spin-off benefits, whereas 90 cents of every dollar spent on heating oil is lost to the economy of Prince Edward Island. The percentage of people cutting their own fuelwood decreased from 52 in 1984-85 to only 23.4 in 1990-91. The governments of Canada and Prince Edward Island have implemented a series of Forest Resource Development Agreements (FRDAs) starting in 1983. The current 1988-1993 FRDA provides USD 24 million for research and incentives for reforestation and management of Prince Edward Island woodlots. It is expected that 3,800 Prince Edward Island woodlot owners will be participating in a woodlot management program by 1993. Silviculture treatments of hardwood stands include thinning, stand conversion (removal of lowgrade softwoods such as balsam fir in mainly hardwood stands), and shelterwood (strip) cutting, particularly in marginal stands. (9 refs.).

25948 (SLU-SKOPRO-R–33, pp. 17-21) **Forest energy production in Switzerland.** Steinmann, P.A. (ETH/SIA, Soral/Ge (Switzerland)). Swedish Univ. of Agricultural Sciences, Garpenberg (Sweden). Dept. of Forest Yield Research. 1992. (CONF-920003–: 1992 IEA workshop, Garpenberg (Sweden), 1992). In *Forest energy production from conventional forestry systems on a small scale*. 35p. Order Number DE93500891. Source: OSTI; NTIS.

Wood fuels are not produced on a large scale in Switzerland. Swiss authorities have recently started programs for making wood fuel production and use more efficient and increase the energy the energy wood consumption. New small scale technology is needed and trials have begun in this area.

25949 (SLU-SKOPRO-R–33, pp. 23-26) **Fuelwood production.** Liss, J.E. (Swedish Univ. of Agricultural Sciences, Garpenberg (Sweden). Dept. of Operational Efficiency); Swartstroem, J. Swedish Univ. of Agricultural Sciences, Garpenberg (Sweden). Dept. of Forest Yield Research. 1992. (CONF-920003–: 1992 IEA workshop, Garpenberg (Sweden), 1992). In *Forest energy production from conventional forestry systems on a small scale*. 35p. Order Number DE93500891. Source: OSTI; NTIS.

A brief overview is given on wood fuel harvesting and handling techniques used by small scale users (farmers) in Sweden.

25950 (SLU-SKOPRO-R–33, pp. 27-35) **Production of forest fuelwood in hardwood stands growing on former farmland.** Johansson, Tord (Swedish Univ. of Agricultural Sciences, Garpenberg (Sweden). Dept. of Forest Yield Research). Swedish Univ. of Agricultural Sciences, Garpenberg (Sweden). Dept. of Forest Yield Research. 1992. (CONF-920003–: 1992 IEA workshop, Garpenberg (Sweden), 1992). In *Forest energy production from conventional forestry systems on a small scale*. 35p. Order Number DE93500891. Source: OSTI; NTIS.

The project has investigated the yield of naturally regenerated stands of broad-leaved trees. Biomass production of alder, birch and aspen may be large enough for commercial production. Cultivation of broad-leaves on farmland in this sense is foreseen to be used in a small-scale activity. Ten stands have been registered by height, diameters and dry weight of twigs and stems. The stands were 18-37 year old. Diameter at breast height was 60-120 mm. Dry weights, tonnes per hectare and year, was 4-6 for alder, 4-6 for Birch and 2-5 for aspen. Total costs per tonnes d.w. was 172-250 SEK for twigs and stems and 222-337 SEK for chips at roadside. Further research is needed for studies in the biological mechanism for sowing alder and birch on farm land with success. Also studies on the cultivation by aspen roots on farm land and the sucker production is necessary. Research on technical solutions of harvesting systems for small scale activity of fuelwood production is needed. (7 refs., 4 figs., 3 tabs.).

0909 Processing

Refer also to citation(s) 25542, 25969, 25980, 25981

25951 (DOE/CE/40903–2) **Membrane vapor recovery systems: Phase 2, Progress report, 1 October 1991–29 September 1992.** Baker, R.W.; Davidson, J.E.; Helm, V.D.; Hofmann, T.R.; Kamaruddin, H.D.; Kaschemekat, J.; Olsen, R.P.; Rose, M.E.; Wijmans, J.G. Membrane Technology and Research, Inc., Menlo Park, CA (United States). [1992]. 44p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC02-90CE40903. Order Number DE93016242. Source: OSTI; NTIS; GPO Dep.

This report describes Phase II of a project to design, construct, and demonstrate in the membrane separation system able to recover volatile organic compounds field a condensation/membrane separation system able to recover volatile organic compounds from effluent air streams. In the first phase of the program, a number of the high-pressure membrane modules to be installed in the system were constructed and evaluated, and the Field Demonstration Unit was designed. In the second phase, the Field Demonstration System was constructed and operated at MTR's laboratories with perchloroethylene, trichlorotrifluoroethane, and hexane, representative of chlorinated hydrocarbons, chlorofluorocarbons and fuel hydrocarbons, respectively. VOC removal from the feed stram was between 80% and 99.8%. Removal increased with increasing VOC content and with decreasing VOC volatility. A Module Field Evaluation Unit was also constructed for testing at the El Dorado plant of Great Lakes Chemical Corporation. The system, consisting of one membrane module housing containing one module insert, is installed on the pressurized vent from a condenser.

25952 (DOE/ER/13359–9) **[Mechanisms of potassium transport in plants and fungi]: Progress report.** Slayman, C.L. Yale Univ., New Haven, CT (United States). [1993]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-85ER13359. Order Number DE93016812. Source: OSTI; NTIS; GPO Dep.

Progress is reported on three front namely survey of ion channels in Arabidopsis; chemical characterization of the tonoplast cation channel (YVC1) in Saccharomyces; and characterization of a fungal proton pump cloned into mammalian cells. Continued work with the yeast plasma-membrane K^+ channel (YPK1) led to clear demonstrations that gating of YPK1 depends upon the disequilibrium voltage for K^+, rather than upon the absolute membrane voltage, and that all channels observable in the yeast plasmalemma are unchanged in primary pump mutants. Preliminary patch-clamp studies on the plasmalemma of Neurospora also identified two conspicuous cation channels in that membrane. A concerted effort to measure cytoplasmic pH in Saccharomyces and Neurospora by means of fluorescent pH indicators evinced two important findings that dyes taken up in (lipophilic) heavily esterified forms accumulate in vacuoles, not in the cytosol; and that the size and distribution of fungal vacuoles can be manipulated dramatically by altering carbon metabolism.

25953 (DTH-LET-RE–93-3) **Gasification of wood chips.** Henriksen, U.; Christensen, O.; Kofoed, E. Danmarks Tekniske Hoejskole, Lyngby (Denmark). Lab. for Energiteknik. May 1993. 27p. (In Danish). Order Number DE93500184. Source: OSTI; NTIS.

Calculation models and results of experiments with the gasification of wood chips are presented. The aim was to evaluate the composition of the gas and the energy conditions in order to form a basis for the comparison of traditional concurrent, open core and two-step gasifiers. It was investigated how the two-step gasifier functioned with wood chips as fuel. It is concluded that in order to achieve high cold gas efficiency and specific heating values of the produced gas, preheating and/or externally heated pyrolysis is necessary. In the case of gasifiers without preheating facilities, the use

of dry wood will improve both cold gas efficiency and specific heating values. The two-step gasifier is well-suited for the gasification of wood chips even with varying moisture conditions. The capacity of the reactor is higher for wood chips than for straw. The composition of the gas is stable and no tar was observed in the gas. (AB).

25954 (ETSU-B–1314) **Assessment of d-RDF processing costs.** Aspinwall and Co. Ltd., Shrewsbury (United Kingdom). 1993. 117p. Order Number DE93506439. Source: OSTI; NTIS (US Sales Only); INIS.

The objectives of the project are:- to define on optimum process flowline for the production of a densified (a hard pellet) form of refuse derived fuel, d-RDF, which includes an aerobic composting module and a non-ferrous metal module; to produce capital and operating cost data; to develop a computer model for economic analysis of the systems; and to develop a computer model for the economic analysis the system with the addition of an Anaerobic Digestion module. (author)

25955 (ETSU-B/MS–00192/30/REP) **Preliminary review of the energy considerations in dewatering and drying sewage sludge to produce a fuel.** Halcrow Gilbert Associates Ltd., Swindon (United Kingdom). 1993. 40p. Order Number DE93504798. Source: OSTI; NTIS (US Sales Only).

This report sets into context the reasons why the energy content of sewage sludge may be exploited under UK circumstances. The characteristics of sewage sludges and their dewaterability are reviewed. Sewage sludge dewatering techniques and equipment in common use are described, with particular focus on filter plate/membrane presses, filter belt presses and centrifuges. The review includes a historical perspective, a process description and a brief resume of recent developments. The performance of various equipment in the field is also given. (author)

25956 (NEI-DK–1187) **Pre-and after-treatment of household wastes which have been sorted at the source for use in the production of biogas.** Jysk Biogas, Farsoe (Denmark). May 1993. 112p. (In Danish). Contract ENS-51161-91.0017. Order Number DE93500146. Source: OSTI; NTIS; INIS.

Up to half of the total amount of household wastes is made up of organic material which can be used in biomass conversion plants for the production of methane. By utilizing thermophillic conditions (about 55 degrees celcius) hygienic conditions are achieved, as bacteria cannot live under these conditions. The de-gassed wastes will still contain nitrates and minerals so they can be used as fertilizers. During anaerobic digestion methane is given off which can be used in gas engines as a fuel supplement to electricity and heat production. Household wastes can be gathered in plastic bags, and a certain amount of inorganic wastes (such as plastics) have unfortunately been found mixed in with the organic wastes. The experiments aimed at a solution to the sorting problem are described in relation to an actual biomass conversion plant where different types of household wastes and manures materials were used for anaerobic digestion. The treatment of the wastes before use in the plant is explained. A satisfactory and economical method of collection, sorting and use of household wastes was found. The stirring system separated the plastic from the organic wastes. 200 cubic meters of biogas was obtained from one cubic meter of waste materials, and the total amount of ammonia content was acceptable. A two-hour process of anaerobic digestion at 55/56 degrees centigrade resulted in hygienic conditions. Most of the weed seeds were killed in the process, this is important with regard to spreading weeds in the fields via the fertilizers. The energy balance was positive and there were minimal odour problems. (AB).

25957 (NEI-DK–1199) **Biogas production: (A) The effect of fish oil and bentonite (bleaching clay) on biogas production. (B) Removal of H_2S with the addition of $FeC1_2$ to the manure in biogas production.** Rockson, J.K. Nordvestjysk Folkecenter for Vedvarende Energi, Hurup (Denmark). Oct 1992. 55p. Order Number DE93500164. Source: OSTI; NTIS.

Hydrogen sulphide (H_2S) causes corrosion to metal components in biomass conversion plants. Many attempts have been to eradicate H_2S. The scrubbing method has proved to be expensive because of the need for very high pressure. The filtering method requires continuous or regular washing and changing or replacement of the filters. Adding ferrous chloride ($FeCL_2$) to the manure to eradicare the H_2S is found to be efficient, less labour intensive; time saving and economical. With regard to the increase in gas quantity by the addition of fish-oil-waste and benetonite (bleaching clay) to the manure, the result is every promising. The production of gas is thought to be increased by this means, which is the reason why the production of methane (CH_4) per. kg. volatile solid (VS) can be doubled. Most important, the whole transaction is economically viable. (AB).

25958 (NEI-DK–1204) **Pilot project concerning the establishment of a collective biomass conversion plant on the island of Mors.** Hedeselskabet, Viborg (Denmark). Miljoeteknisk Afd. Jun 1993. 101p. (In Danish). Contract ENS-51161-92.0075. Order Number DE93500212. Source: OSTI; NTIS; INIS.

This pilot project comprises a feasibility study in connection with plans to establish a biomass conversion plant, on the Danish island of Mors, which would provide methane to be used as fuel, in combination with natural gas, for a cogeneration plant serving six villages. The subjects of location, organization, the transportation of biomass, the design of the biomass conversion plant, economical aspects and conditions of the use of the methane are discussed as a basis for decisions in this respect. Environmental considerations are also dealt with. (AB).

25959 (NEI-DK–1206) **Thorsoe environmental and biogas plant Amba: Final report.** Bioplan Miljoekonsulenter ApS, Viborg (Denmark). Jan 1993. 127p. (In Danish). Contract ENS-51161-92.0035. Order Number DE93500201. Source: OSTI; NTIS.

A detailed description is given of a feasibility study concerning the establishment of a biomass conversion plant in Thorsoe, Denmark. A group of Danish farmers were the initiators. The aim was to promote the use of methane produced by the plant in combination with natural gas in relation to a cogeneration plant, and to discover how much such project would cost. The background for the initiative is given and the biogas concept, dealings with local authorities, tenders, budgets and financing are all described in addition to the design of the involved cogeneration plant. The text is illustrated with diagrams of the setup and relevant data. (AB).

25960 (NEI-DK–1209) **Technical and economical evaluation of methods for online determination of volatile fatty acids.** Krueger, I. WasteSystems A/S, Soeborg (Denmark). May 1993. 12p. (In Danish). Contract ENS-1383/91-0001. Order Number DE93500393. Source: OSTI; NTIS.

EFP-91.

This technical and economical evaluation of methods for the online determination of volatile fatty acids (VFA) relates to biomass conversion plants. Methods involving titration, gas chromatography and mass spectrometry are dealt with. It is stated that only titration of the total content of volatile fatty acids has reached a stage where it could be commercially interesting. A whole system for VFA analysis and control and regulation would currently cost 400.000 - 500.000 Danish kroner. In order for this to be economically feasible it would be necessary for the biomass conversion plant to produce 2-5% more methane. The three methods are briefly explained, and their accuracy and stage of development are discussed. Economical aspects are more extensively dealt with. (AB).

25961 (UCRL-JC–110663) **Biomimetic catalysts: Application of coordinating complexes containing an asymmetric coordinating ligand.** Droege, M.W. (Lawrence Livermore National Lab., CA (United States)); Satcher, J.H. Jr.; Reibold, R.A.; Watkins, B.E.; Weakely, T.J.R.; Chauffe, L. Lawrence Livermore National Lab., CA (United States). 15 May 1992. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-920815–21: 204. American Chemical Society (ACS) national meeting, Washington, DC (United States), 23-28 Aug 1992). Order Number DE93009228. Source: OSTI; NTIS; GPO Dep.

The catalytic conversion of methane from natural gas into a readily transportable liquid fuel is a research area that is currently attracting considerable attention. This is a difficult transformation from a thermodynamic viewpoint since methane is a relatively unreactive substance and chemicals derived from methane are substantially more reactive than methane itself. Thus, no industrial

process to date has been able to convert methane to liquid products in high yield. One of the more studied process is the oxidative coupling of methane to higher hydrocarbons and olefins. We undertook a program to take advantage of the selectivity already known to exist in a bacterial enzyme system. A group of aerobic soil/water bacteria called methanotrophs can efficiently and selectively utilize methane as the sole source of energy and carbon for cellular growth. The first reaction in this metabolic pathway is the conversion of methane to methanol and is catalyzed by the enzyme methane monooxygenase (MMO). Our work centers on the characterization of the structure/activity relationships of the particulate form of MMO and synthesis and characterization of inorganic/organic chemical models of MMO (both particulate and soluble).

0910 Properties and Composition

25962 (SNV–4161) **Incineration of sorted industrial wastes: Basic report: Waste characterization.** Viberg, T. (Miljoekonsulterna i Studsvik AB, Nykoeping (Sweden)); Oehrstroem, T. Swedish Environmental Protection Agency, Solna (Sweden); Swedish National Board for Industrial and Technical Development (NUTEK), Stockholm (Sweden); Svenska Renhaallningsverksfoereningen, Malmoe (Sweden); Miljoekonsulterna i Studsvik AB, Nykoeping (Sweden). Sep 1992. 34p. (In Swedish). (NUTEK-AVF–93-1;RVF–92-17-1;MKS–92-74). Order Number DE93500872. Source: OSTI; NTIS.

Characterization and preparation of industrial wastes from several different swedish sources for use in incineration plants are described. Comparative combustion tests were performed at the Borlaenge incineration plant. Each waste-type was analyzed according to its content of wood, paper, laminates, plastics, rubbers, textiles, metals, and other combustible/non-combustible materials. (16 figs., 10 tabs.).

0920 Combustion

Refer also to citation(s) 25973, 25979, 26558, 26719

25963 (DOE/CE/15425–T11) **Biomass energy: State of the technology present obstacles and future potential.** Dobson, L. Northern Light R&D, Seattle, WA (United States). 23 Jun 1993. 113p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG01-89CE15425. Order Number DE93016295. Source: OSTI; NTIS; GPO Dep.

The prevailing image of wood and waste burning as dirty and environmentally harmful is no longer valid. The use of biomass combustion for energy can solve many of our nation's problems. Wood and other biomass residues that are now causing expensive disposal problems can be burned as cleanly and efficiently as natural gas, and at a fraction of the cost. New breakthroughs in integrated waste-to-energy systems, from fuel handling, combustion technology and control systems to heat transfer and power generation, have dramatically improved system costs, efficiencies, cleanliness of emissions, maintenance-free operation, and end-use applications. Increasing costs for fossil fuels and for waste disposal strict envirorunental regulations and changing political priorities have changed the economics and rules of the energy game. This report will describe the new rules, new playing field and key players, in the hopes that those who make our nation's energy policy and those who play in the energy field wig take biomass seriously and promote its use.

25964 (ETDE-IT–93-166) **Biomass combustion: Italian ENEA experimental plant.** Chiado Rana, M. ENEA, Saluggia (Italy). Area Nucleare. 1992. 19p. (In Italian). (CONF-9207206–1: Utilizzo delle biomasse agricole nella produzione energetica, Saluggia (Italy), 2 Jul 1992). Order Number DE93799189. Source: OSTI; NTIS (US Sales Only); INIS.

This paper outlines the key design features of an experimental biomass combustion plant built at the ENEA (the Italian Agency for New Technology, Energy and the Environment) Saluggia research center. Based on the results of performance tests using rice husks as fuel, indications are given as to the energy efficiency, economic feasibility and environmental compatibility of the innovative biomass combustion process.

25965 (ETSU-B–1278) **Development of a chain grate stoker for d-RDF combustion.** Senior Thermal Engineering Ltd., Wakefield (United Kingdom). 1993. 118p. Order Number DE93506438. Source: OSTI; NTIS (US Sales Only).

This project is part of the Department of Trade Industry's programme to establish the technical viability of d-RDF as a fuel. d-RDF combustion trials on shell boilers forms an integral part of this programme. The objectives of the project are: to develop the combustion system for 100% d-RDF firing to the point where the system can be applied commercially with confidence; to present the range of measures required to retrofit existing equipment for d-RDF firing, with an analysis of costs and expected savings, areas of technical uncertainty and likely environmental impact; to assess the relative merits of d-RDF firing alone or as a admixture with coal; and to suggest modifications that should be made to the system if purchased as a new installation, with an estimate of the marginal costs involved. (author)

25966 (NUTEK-VK–93-9) **Analysis of wood powder combustion in a diesel engine.** Olsson, Erik (Chalmers Univ. of Technology, Gothenburg (Sweden). Dept. of Thermo and Fluid Dynamics). Swedish National Board for Industrial and Technical Development (NUTEK), Stockholm (Sweden). 1993. 39 p.p. (In Swedish). Project NUTEK-566-032. Order Number DE93500755. Source: OSTI; NTIS.

The aim of this project is to investigate the economics of a wood powder fueled diesel engine. Questions also discussed are the reduction in efficiency compared to oil as a fuel, and the expected effects on service life and maintenance cost. The analysis shows that the concept is economically defendable compared to other biomass fueled power plants. It seems also to be technically feasible. (9 refs., 4 figs.).

25967 (SNV–4160) **Incineration of sorted industrial wastes: Main report.** Swedish Environmental Protection Agency, Solna (Sweden); Swedish National Board for Industrial and Technical Development (NUTEK), Stockholm (Sweden); Svenska Renhaallningsverksfoereningen, Malmoe (Sweden). Nov 1992. 39 p.p. (In Swedish). (NUTEK-AVF–93-1;RVF–92-17). Order Number DE93500869. Source: OSTI; NTIS.

The aim of the project has been to evaluate suitable combustion technologies and environmental consequences of waste incineration, and to suggest classification criteria of sorted industrial wastes. Industrial wastes have been sampled at six swedish sites with already established programs, and transported to one of these sites for incineration tests. For each of the six different waste categories the following properties were determined: Calorific content, Carbon dioxide emission, Ash composition, Flue gas emissions, and Incinerator design. (12 figs., 14 tabs.).

25968 (SNV–4162) **Incineration of sorted industrial wastes: Basic report: Incineration tests.** Bergstroem, J. (Miljoekonsulterna i Studsvik AB, Nykoeping (Sweden)); Oehrstroem, T. Swedish Environmental Protection Agency, Solna (Sweden); Swedish National Board for Industrial and Technical Development (NUTEK), Stockholm (Sweden); Svenska Renhaallningsverksfoereningen, Malmoe (Sweden); Miljoekonsulterna i Studsvik AB, Nykoeping (Sweden). Sep 1992. 74p. (In Swedish). (NUTEK-AVF–93-1;RVF–92-17-2;MKS–93-83). Order Number DE93500877. Source: OSTI; NTIS.

Industrial wastes of different provenance (six in all, and one mixture of two of those) were incinerated in a testing campaign for 24 hours each. In this report, measurements from the tests are reviewed, including flue gas emissions, ash and slag analysis, heat and moisture content of the fuel, and analysis of organic chlorine compounds and trace metals. (13 figs., 59 tabs.).

0930 Economic, Industrial, and Business Aspects

Refer also to citation(s) 25947, 25954, 25958, 25964, 26114, 26448

25969 (ETDE-IT–93-192) **Wood biomass gasification: Technology assessment and prospects in developing countries.** Salvadego, C. ENEA, Casaccia (Italy). Area Energetica. May 1992. 96p. (In Italian). Order Number DE93799205. Source: OSTI; NTIS (US Sales Only); INIS.

This investigation of the technical-economic feasibility of the development and use of wood biomass gasification plants to help meet the energy requirements of developing countries covers the following aspects: resource availability and production; gasification technologies and biomass gasification plant typology; plant operating, maintenance and safety requirements; the use of the biomass derived gas in internal combustion engines and boilers; and the nature of energy requirements in developing countries. The paper concludes with a progress report on biomass gasification research programs being carried out in developing countries world-wide.

25970 (ETSU-B–1322) **Farmers' current attitudes to energy forestry in Great Britain.** Tranter, R.B.; Carruthers, S.P.; Jones, P.J.; Miller, F.A. Reading Univ. (United Kingdom). Centre for Agricultural Strategy. 1993. 148p. Order Number DE93505271. Source: OSTI; NTIS (US Sales Only); INIS.

The objectives of the project were twofold: first, to assess the current level of interest in energy coppice among farmers in GB and, hence, its present potential as a farm enterprise; and, second, to gauge the effects of any changes in the agricultural situation and in the 'state-of-the-art' of energy coppice that have occurred since a similar study was carried out some five years ago. (Author)

25971 (NUTEK-R–92-31) **Waste -92: Fuel from household and industry waste.** Ekwall, K. (Svenska Renhaallningsverksfoereningen, Stockholm (Sweden)). Swedish National Board for Industrial and Technical Development (NUTEK), Stockholm (Sweden). Nov 1992. 39p. (In Swedish). Order Number DE93500661. Source: OSTI; NTIS; INIS.

The report gives a review of waste incineration in Sweden today, including environmental and legal aspects. 21 incinerator plants are in use, producing heat to district heating network and, to a minor part, electric power. In 1991 1.31 Mton household waste and 0.35 Mton industrial waste were incinerated producing 4.4 Twh of energy. In a few cities 30-40 percent of the district heat comes from waste incineration. The theoretical and practical potentials for energy production in Sweden are estimated to 7 respective 5 TWh for household waste and 9 respective 5-6 TWh for industrial waste. Landfill gas is extracted at about 35 sites, with a yearly production of 0.3 TWh which corresponds to 3-5 percent of the potentially recoverable quantity. (8 refs., 2 figs., 13 tabs.).

0940 Transport, Handling, and Storage

Refer also to citation(s) 25956, 25958

25972 (VF-UB–92-46) **Long-distance transport of bioenergy fuel to VEGA.** Brunberg, B. Vattenfall AB, Vaellingby (Sweden). Dec 1992. 75 p.p. (In Swedish). Order Number DE93500933. Source: OSTI; NTIS.

A planned erection of VEGA, a pressurized gasifier with combined cycle, at Eskilstuna in Sweden, would increase the risk of insufficient bioenergy fuel being available within the traditional procurement area, i.e. within a mean transport distance of 70-80 km. However, there is likelihood that VEGA's fuel requirements cannot be met, given that fuel can be brought in from further afield by rail or water. It is estimated that large volumes of both logging residue and sawmill residues would be available in the Bergslagen and southern Norrland regions of the country. Taking the fuel by sea from the mills on the coast to a suitable dock on Lake Maelaren would entail the additional cost of transporting it by road from the dock to the VEGA plant, as a result of which road haulage for the entire stretch would be more economical over distances of up to 170-180 km. Yet, compared with road haulage, sea transport would offer more scope for negotiating lower fuel prices. Rail transport appears to be a realistic option. The proposed VEGA site is very close not only to the railway but also to several sawmills in the region concerned. In addition, rail transport is currently being developed and analysis of the costs has shown it to be competitive. Depending on the fuel assortment to be carried, rail transport can compete with road haulage over distances of 80-130 km. (8 refs., 26 figs.).

0950 Environmental Aspects

Refer also to citation(s) 25956, 25964, 27315

25973 (ETSU-B–1313-P2) **An emissions audit from a chain-grate stoker burning d-RDF.** Jackson, P.M.; King, P.G. Warren Spring Lab., Stevenage (United Kingdom). 1993. 107p. Contract E/5A/1313/2450;Project WSL 3311X. (WSL-CR–3523(MR)). Order Number DE93504810. Source: OSTI; NTIS (US Sales Only); INIS.

This report describes the Emissions Audit carried out on a chain-grate stoker shell boiler burning dRDF at the Senior Foster Wheeler test facility in Wakefield to provide design data for gas cleaning equipment. Sampling was therefore performed in the absence of any abatement equipment other than a standard cyclonic grit arrestor. The chain-grate stoker boiler was tested at two steam loads: 40% MCR to represent low load and, 80% MCR to represent high steam load. Acid gas concentrations in the flue gas were unacceptable. The dominant gas being HCl at 850-1000mgm^{-3} for both tests, was considerably higher than the guideline for new plant of 50mgm^{-3}. HF was also measured at concentrations in excess of the guidance value. It will be necessary to install acid gas scrubbing equipment before dRDF will be acceptable as a fuel. SO_2 and NO_x were both present in measurable concentrations but under current guidance were no cause for concern. (author)

25974 (ETSU-B–1313-P4) **An emissions audit of a biomass combustor burning treated wood waste.** Jackson, P.M.; Jones, H.H.; King, P.G. Warren Spring Lab., Stevenage (United Kingdom). 1993. 101p. (WSL-CR–3560(MR)). Order Number DE93505272. Source: OSTI; NTIS (US Sales Only); INIS.

This report describes the Emissions Audit carried out on a Biomass Combustor burning treated wood waste at the premises of a furniture manufacturer. The Biomass Combustor was tested in two firing modes; continuous fire and modulating fire. Combustion chamber temperatures and gas residence times were not measured. Boiler efficiencies were very good at greater than 75% in both tests. However, analysis of the flue gases indicated that improved efficiencies are possible. The average concentrations of CO (512mgm^{-3}) and THC (34mgm^{-3}) for Test 1 were high, indicating that combustion was poor. The combustor clearly does not meet the requirements of the Guidance Note for the Combustion of Wood Waste. CO_2 and O_2 concentrations were quite variable showing that combustion conditions were fairly unstable. Improved control of combustion should lead to acceptable emission concentrations. (Author)

25975 (ETSU-B–1313-P5) **An emissions audit of a purpose built whole bale straw combustor.** Jackson, P.M.; Jones, H.H.; King, P.G. Warren Spring Lab., Stevenage (United Kingdom). 1993. 89p. (WSL-CR–3592(MR)). Order Number DE93504519. Source: OSTI; NTIS (US Sales Only); INIS.

This report describes an Emissions Audit carried out on a purpose built whole bale straw combustor developed by Henley Burrowes and Co. Ltd in association with ETSU. To gain a true assessment of the emissions from the unit, tests were conducted with the abatement equipment not operating. The whole bale straw combustor was tested at one operating condition, the two tests performed indicated good reproducibility of operation. Gas phase temperatures of 1100°C and 960°C were measured in the primary and secondary combustion chambers respectively. Gas residence times in these chambers were not measured. The boiler efficiency was measured by two methods, both giving a value of 67%. This efficiency was quite low, but due to site restrictions the boiler had been down graded to produce hot water instead of steam. (Author)

25976 (ETSU-B/MS–00192/05/REP) **Economic assessment of emissions abatement for small-scale waste combustion.** ECOTEC Research and Consulting Ltd., Birmingham (United Kingdom). 1993. 116p. Order Number DE93505270. Source: OSTI; NTIS (US Sales Only); INIS.

This report presents a preliminary economic assessment of various pollution abatement systems which could be applied to waste combustion projects. For the purpose of this work a rigorous analysis of the technical performance has not been carried out. Costs for plants have been obtained from UK manufacturers against specifications from three plants at different scales. The manufacturers were free to submit any design they felt was capable of achieving the required performance and a wide range of designs were received. The economic analysis was designed to examine

comparative capital costs and attempt to assess the overall annualised costs by calculation of the running costs for each system. The study shows that simple comparisons on capital cost are insufficient to determine the most cost effective method of pollution abatement. In addition several areas of uncertainty exist in both technical performance and costs of these systems. (Author)

25977 (VF-UB–93-10) **Forest fuel reduces the nitrogen load.** Lundborg, A. Vattenfall AB, Vaellingby (Sweden). Mar 1993. 93 p.p. (In Swedish). Order Number DE93500942. Source: OSTI; NTIS; INIS.

A study of the literature was made on the basis of the following hypothesis: "If nitrogen-rich felling residues are removed from the forest, the nitrogen load on the forest ecosystem is decreased and the risk of nitrogen saturation also decreases". The study was designed to provide information on how the nitrogen situation is influenced if felling residues are removed from nitrogen-loaded forests and used as fuel. Felling residues release very little nitrogen during the first years after felling. They can immobilize nitrogen from the surroundings, make up a considerable addition to the nitrogen store in the soil, but also release nitrogen in later stages of degradation. The slash has an influence on the soil climate and thus on soil processes. Often there is an increase in the mineralization of litter and humus below the felling residues. At the same time, nitrification is favoured, particularly if the slash is left in heaps. Felling residues contain easily soluble nutrients that stimulate the metabolization of organic matter that otherwise is rather resistant to degradation. The slash also inhibits the clear-cut vegetation and its uptake of nitrogen. These effects result in increased leaching of nitrogen and minerals if the felling residues are left on the site. (99 refs.).

0960 Health and Safety

25978 (IVL-B–1088) **The work environment at thermal power plants using biofuel and peat. Presence and concentrations of airborne micro-organisms, endotoxins and dust and proposals to control measures.** Davila, E. Alvarez de; Bengtsson, L. Swedish Environmental Research Inst., Stockholm (Sweden). Jan 1993. 42p. (In Swedish). Order Number DE93500708. Source: OSTI; NTIS.

In the present study the concentration of airborne micro-organisms (fungi, bacteria), endotoxins and dust have been measured at three thermal power plants. Two of the plants used wood fuel and one used peat. The measurements were carried out as stationary measurements at different positions along the handling of biofuel at delivery, transportation and storage. Personal samples were taken in the reception hall when fuel from trucks were tipped and when the plant was rounded. The levels of bacteria, fungi, endotoxins and dust varied between different positions in the plants and between the three plants. The concentration varied according to type of fuel, fuel quality, the construction of the plants and the way in which the fuel was handled. The stationary samples showed higher concentrations of bacteria and fungi at the plant using peat. Enhanced concentrations were measured when old stored peat was used. The concentration of endotoxins was low in all three plants. The highest concentration of endotoxins was found during unloading of old stored wood fuel. Respiratory symptoms have been observed among the personnel at the plant using peat. A review has been made of the literature about health hazards after exposure to micro-organisms, endotoxins and dust from biofuel (wood and peat). Recommendations for improvement of the work environment are included in the report. (25 refs., 11 figs., 4 apps.).

0980 Waste Management

Refer also to citation(s) 26547

25979 (ETSU-B–1374) **Production and combustion of c-RDF for on-site power generation.** Gulley, B.; Burnett, S. Aspinwall and Co., Shrewsbury (United Kingdom). 1992. 47p. Order Number DE93504795. Source: OSTI; NTIS (US Sales Only).

This report describes work commissioned by ETSU (on behalf of the Department of Trade and Industry) to assess the production and combustion of coarse refuse derived fuel (c-RDF), and its use as a fuel for power generation on-site at a single plant location. The technical feasibility of c-RDF production, and on-site combustion and power generation has been established, and the financial attractiveness of investment in c-RDF plant has been explored using an economic model and DCF techniques. The results show that c-RDF is a potentially attractive waste management option in areas where waste tonnages of around 200,000 tonnes per annum are available. On the basis of this study the costs and economics of c-RDF production, and combustion and power generation have been shown to be similar to those for mass-burn incineration or bulk transfer to a distant landfill. (author)

0990 Products and By-Products

25980 (ENEA-RT-AMB–91-07) **Agro-industrial anaerobic digestion cost benefits: Technology utilization in distillery.** De Poli, F.; Mela, E.; Pasqualini, S. ENEA, Casaccia (Italy). Area Energia Ambiente e Salute. Feb 1991. 78p. (In Italian). (RT/AMB–91-07). Order Number DE93799213. Source: OSTI; NTIS (US Sales Only).

Anaerobic digestion, followed by aerobic post treatment, is widely used as a treatment technology of distillery wastes. An economic comparison between two different treatment processes; a traditional concentration unit and the termophilic hybrid anaerobic digester, was done. The costs/benefits balance shows the strong advantage of the anaerobic process, even if the value of by-products from the concentrator is higher than the ones from the digester; the operation costs (mainly labour and energy) of the concentrator are strongly higher, and the balance becomes negative. The NPV of the two plants shows always negative values for the concentrator, while the digester can become convenient under some conditions.

10 SYNTHETIC FUELS

1002 Production

Refer also to citation(s) 25525, 25528, 25532

25981 (UCRL-JC–110675) **Biomimetic methane oxidation.** Watkins, B.E.; Droege, M.W.; Taylor, R.T.; Satcher, J.H. Lawrence Livermore National Lab., CA (United States). 12 Jun 1992. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-921152–14: International gas research conference, Orlando, FL (United States), 16-19 Nov 1992). Order Number DE93013196. Source: OSTI; NTIS; GPO Dep.

Methane monooxygenase (MMO) is an enzyme found in methanotrophs that catalyses the selective oxidation of methane to methanol. MMO is protein complex one component of which is a binuclear metal center containing oxygenase. We have completed one round of a design/synthesis/evaluation cycle in the development of coordination complexes that mimic the structure/function of the MMO active site. One of these, a binuclear, coordinately-asymmetric copper complex, is capable of oxidizing cyclohexane to a mixture of cyclohexanol and cyclohexanone in the presence of hydrogen peroxide.

13 HYDRO ENERGY

1306 Environmental Aspects

Refer also to citation(s) 27509

25982 (DOE/BP/21065–1) **Research and recovery of Snake River sockeye salmon: Annual report, 1992.** Johnson, K.A. Idaho Dept. of Fish and Game, Eagle, ID (United States). May 1993. 38p. Sponsored by USDOE, Washington, DC (United States). DOE Contract BI79-91BP21065. Order Number DE93016801. Source: OSTI; NTIS; GPO Dep.

Significant changes were made in the fish rearing facilities at the Idaho Department of Fish and Game's (IDFG) Eagle Hatchery during the contract period. Rearing and develop sampling protocols for genetics and pathology were developed. The rearing protocol was

derived with assistance of the Technical Oversight Committee, the scientific advisory group, and several fish culturists and nutritionists who were consulted informally. The standards were incorporated into the Research and Propagation Permit from National Marine Fisheries Service was applied for during this project period. Pathology and genetics samples have been taken and processed from each fish which died during the rearing phase.

25983 (DOE/BP/41841–1) **Redfish Lake sockeye salmon captive broodstock rearing and research: Annual report, 1992.** Flagg, T.A. (National Marine Fisheries Service, Seattle, WA (United States). Coastal Zone and Estuarine Studies Div.). National Marine Fisheries Service, Seattle, WA (United States). Coastal Zone and Estuarine Studies Div.; USDOE Bonneville Power Administration, Portland, OR (United States). Div. of Fish and Wildlife. Apr 1993. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AI79-92BP41841. Order Number DE93016803. Source: OSTI; NTIS; GPO Dep.

This report summarizes fish culture and research activities conducted from December 1991 to October 1992 by the National Marine Fisheries Service (NMFS) on the Redfish Lake (Idaho) sockeye salmon captive broodstock study. Bonneville Power Administration (BPA) has funded restoration efforts for Redfish Lake sockeye salmon. Snake River sockeye salmon, now represented only by the Redfish Lake population, were formally listed as endangered under the Endangered Species Act (ESA) by the NMFS in December 1991. Restoration is being coordinated through the Stanley Basin Sockeye Technical Oversight Committee. Participation by state and federal agencies and private groups involved in sockeye salmon restoration efforts in Idaho. Our efforts since then have focused on rearing of 1991-brood Redfish Lake sockeye salmon at the NMFS/BPA Stock Restoration Laboratory at the NWFSC (Seattle, Washington), and on research to refine captive-broodstock methodology.

25984 (DOE/BP/60629–1) **Integrated hatchery operations team: Existing policy affecting hatcheries in the Columbia River Basin: Combined reports: Annual report, 1992.** Shelldrake, T. (Fish and Wildlife Service, Portland, OR (United States)). USDOE Bonneville Power Administration, Portland, OR (United States). Div. of Fish and Wildlife; Fish and Wildlife Service, Portland, OR (United States). May 1993. 226p. Sponsored by USDOE, Washington, DC (United States). DOE Contract BI79-91BP60629. Order Number DE93016804. Source: OSTI; NTIS; GPO Dep.

Collected together in this document is relevant laws and policy of the US Fish and Wildlife Service, Washington State Department of Wildlife, Oregon State, Washington Department of Fisheries, and Idaho Department of Fish and Game as they affect hatcheries in the Columbia River Basin.

25985 (DOE/BP/60629–2) **Integrated hatchery operations team: Operation plans for anadromous fish production facilities in the Columbia River Basin: Annual report 1992, Volume 3.** Christianson, C. (Oregon Dept. of Fish and Wildlife, Portland, OR (United States)). Oregon Dept. of Fish and Wildlife, Portland, OR (United States); USDOE Bonneville Power Administration, Portland, OR (United States). Div. of Fish and Wildlife. Apr 1993. 324p. Sponsored by USDOE, Washington, DC (United States). DOE Contract BI79-91BP60629. Order Number DE93016805. Source: OSTI; NTIS; GPO Dep.

This volume contains the annual operations report and plans for the coming year for 20 hatcheries on the Columbia River.

25986 (DOE/BP/60629–3) **Integrated hatchery operations team: Operation plans for anadromous fish production facilities in the Columbia River Basin: Annual report 1992, Volume 4.** Peck, L. (Washington Dept. of Fisheries, Olympia, WA (United States)). Washington Dept. of Fisheries, Olympia, WA (United States); USDOE Bonneville Power Administration, Portland, OR (United States). Div. of Fish and Wildlife. Apr 1993. 226p. Sponsored by USDOE, Washington, DC (United States). DOE Contract BI79-91BP60629. Order Number DE93016806. Source: OSTI; NTIS; GPO Dep.

Operational plans for Cowlitz, Elokomin, Grays River, Kalama Falls, Lewis River and Speelyai, Lower Kalama, Lyons Ferry, Methow, Priest Rapids, Ringold Springs, Rock Island, Toutle, Washougal, and Wells Salmon Hatcheries are individually described.

25987 (DOE/BP/60629–5) **Operation plans for anadromous fish production facilities in the Columbia River Basin: Volume 2: Idaho Department of Fish and Game Hatcheries, Annual report 1992.** Hutchison, B. (Idaho Dept. of Fish and Game, Boise, ID (United States)). Idaho Dept. of Fish and Game, Boise, ID (United States); USDOE Bonneville Power Administration, Portland, OR (United States). Div. of Fish and Wildlife. May 1993. 90p. Sponsored by USDOE, Washington, DC (United States). DOE Contract BI79-91BP60629. Order Number DE93016808. Source: OSTI; NTIS; GPO Dep.

Operational plans for Clearwater, Magic Valley, McCall, Niagara Springs Steelhead, Oxbow, Pahsimeril, Rapid River, and Sawtooth Hatcheries are individually described.

25988 (DOE/BP/92818–1) **Migratory characteristics of spring chinook salmon in the Willamette River: Annual report, 1991.** Snelling, J.C.; Schreck, C.B.; Bradford, C.S.; Davis, L.E.; Slater, C.H.; Beck, M.T.; Ewing, S.K. Oregon State Univ., Corvallis, OR (United States). Dept. of Fisheries and Wildlife. May 1993. 47p. Sponsored by USDOE, Washington, DC (United States). DOE Contract BI79-88BP92818. Order Number DE93016802. Source: OSTI; NTIS; INIS; GPO Dep.

This report documents our research to examine in detail the migration of juvenile and adult spring chinook salmon in the Willamette River. We seek to determine characteristics of seaward migration of spring chinook smolts in relation to oxygen supplementation practices at Willamette Hatchery, and to identify potential sources of adult spring chinook mortality in the Willamette River above Willamette Falls and use this information towards analysis of the study on efficiency of oxygen supplementation. The majority of juvenile spring chinook salmon released from Willamette hatchery in 1991 begin downstream movement immediately upon liberation. They travel at a rate of 1.25 to 3.5 miles per hour during the first 48 hours post-release. Considerably slower than the water velocities available to them. Juveniles feed actively during migration, primarily on aquatic insects. Na^+/K^+ gill ATPase and cortisol are significantly reduced in juveniles reared in the third pass of the Michigan series with triple density and oxygen supplementation, suggesting that these fish were not as well developed as those reared under other treatments. Returning adult spring chinook salmon migrate upstream at an average rate of about 10 to 20 miles per day, but there is considerable between fish variation. Returning adults exhibit a high incidence of wandering in and out of the Willamette River system above and below Willamette Falls.

25989 (DOE/BP/94402–7) **Columbia River coordinated information system report on information needs.** Weber, E. (Columbia River Inter-Tribal Fish Commission, Portland, OR (United States)); Roseberry, A.C.; Petrosky, C.; Allen, S.; Kinney, W.J.; Rowe, M. Columbia River Inter-Tribal Fish Commission, Portland, OR (United States); Idaho Dept. of Fish and Game, Boise, ID (United States); Washington Dept. of Fisheries, Olympia, WA (United States); Shoshone-Bannock Tribe, Fort Hall, ID (United States). May 1993. 162p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG79-89BP94402. Order Number DE93016701. Source: OSTI; NTIS; GPO Dep.

Successful application of adaptive management to rebuilding the Columbia Basin's anadromous fish resources requires that available information and experience be organized and shared between numerous organizations and individuals. Much of this knowledge exists only in unpublished form in agency and individual files. Even that information which is published in the form of technical and contract reports receives only limited distribution and is often out of print and unavailable after a few years. Only a small fraction of the basin's collective knowledge is captured in permanent and readily available databases and recognized journals. State, tribal, and federal fishery managers have recognize these information management problems and have committed to a program, the Coordinated Information System Project, to capture and share more easily the core data and other information upon which management decisions are based. That project is now completing the process of scoping and identification of information needs. Construction of prototype systems will begin in 1992. This report is one

in a series of seven describing the results of the Coordinated Information on System scoping and needs identification phase.

25990 (DOE/BP/98852–1) **Above Bonneville passage and propagation cost effectiveness analysis: Technical report, January 1993.** Paulsen, C.M.; Hyman, J.B.; Wernstedt, K. Resources for the Future, Inc., Washington, DC (United States). May 1993. 214p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC79-89BP98852. Order Number DE93016702. Source: OSTI; NTIS; INIS; GPO Dep.

We have developed several models to evaluate the cost-effectiveness of alternative strategies to mitigate hydrosystem impacts on salmon and steelhead, and applied these models to areas of the Columbia River Basin. Our latest application evaluates the cost-effectiveness of proposed strategies that target mainstem survival (e.g., predator control, increases in water velocity) and subbasin propagation (e.g., habitat improvements, screening, hatchery production increases) for chinook salmon and steelhead stocks, in the portion of the Columbia Basin bounded by Bonneville, Chief Joseph, Dworshak, and Hells Canyon darns. At its core the analysis primarily considers financial cost and biological effectiveness, but we have included other attributes which may be of concern to the region.

25991 (VF-H–92-1) **Environmentally adjusted oil and grease.** Andersson, Bert; Lindberg, J. (eds.). Vattenfall AB, Vaellingby (Sweden). 1992. 65p. (In Swedish). Order Number DE93500672. Source: OSTI; NTIS; INIS.

With the intention of maintaining healthy environment in our rivers Vattenfall in 1988 initiated a project called 'Environmentally friendly oils'. The goal was to find oils for bearings and hydraulic systems that would cause less negative environmental effects and still maintain a good technical function. Based on the results of the project it is recommended, for both economical and environmental reasons, to change to synthetic oil in bearings and to hydraulic oil made of white oil in regulating systems. The change may be carried out in connection to other work on the system in question. Special care is recommended when cleaning the system from old oil and dirt. In order to maintain the high quality of the oil, also during manufacturing and assembling, one should follow the recommendations outlined in the report. In bearings where used grease leaks into the river, a grease made of white oil should be used. The quality of the rubber sealings must be adapted to the oil used, in order to secure a good function. In order to bring down the number of products and to create an open market some additional changes is necessary in the specifications of oil. Further research regarding oil and sealing is planned. (3 refs.).

25992 (VF-H–92-5) **Fish barriers: Methods to divert fish (avoidance, attraction) at hydroelectric power installations.** Larsson, Mats (Vattenfall HydroPower AB, Vaellingby (Sweden)). Vattenfall AB, Vaellingby (Sweden). Nov 1992. 94p. (In Swedish). Order Number DE93500675. Source: OSTI; NTIS; INIS.

In addition to literature reviews laboratory experiments with both strobe light and different kinds of sound stimuli were carried out. In the experiments silver eel, brown trout, arctic char and salmon smolts were tested. The experiments showed that in darkness silver eel avoided strobe light with intensities between 0.4 and 8.7 lux with 80-90% avoidance in 8.7 lux. The avoidance reactions decreased when background light was raised to 9 lux. Brown trout did not show as strong avoidance reactions possibly due to aggressive behaviour between different individuals of brown trout. The avoidance reaction was however more pronounced in dim background lift with an intensity of 5 lux than in darkness. The experiments also showed that the avoidance reactions started within a few seconds after exposure to strobe light. The frequencies 6.0 and 15 Hz were more effective as triggers of avoidance reactions than were the frequencies 2.1 and 160 Hz. Arctic char did not show any avoidance reactions to strobe light. It was actually attracted to strobe light with the frequency 160 Hz in total darkness and indifferent in dim background light 10 lux. Experiments in running water also showed that salmon smolts could be diverted from an area exposed to strobe light with the frequency 15.0 Hz. The effect was more pronounced in darkness than in dim background light and also more pronounced when water current was 20 cm/s than when it was 40 or 60 cm/s. Experiments to test the avoidance reactions to sound was also performed. The evaluation of these results where however complicated by the fact that the fishes swam rapidly to and fro in the experimental chamber and thus by pure chance very frequently were close to the sound generator.

1308 Health and Safety

25993 (VF-H–92-6) **Ageing in embankment dams: Pilot study.** Nilsson, Aake (VBB VIAK, Stockholm (Sweden)); Norstedt, U. Vattenfall AB, Vaellingby (Sweden). Dec 1992. 45 p.p. (In Swedish). Order Number DE93500678. Source: OSTI; NTIS.

In this pilot study the ongoing work in the ICOLD Subcommittee on ageing of earth and rockfill dams is described. The following ageing scenarios are presented in detail: *Ageing of foundation materials resulting in internal erosion. *Ageing of embankment materials resulting in internal erosion. * Ageing of embankment materials resulting in surface erosion. *Ageing resulting in loss of bond between concrete structures and the embankment. From the statistics of a number of cases reported by ICOLD committee on deterioration of dams and reservoirs it is concluded that deterioration resulting in surface erosion is the most common deterioration after percolation in the foundation and dam body. However, it should be noted that among the cases with surface erosion no failure has been reported. Attention should also be drawn to the frequency of failures related to bonding between structures and adjoining embankments. It may be pointed out that bonding between structures and adjoining structures and internal erosion in the dam body are the types of deterioration with the highest probability of causing failures. Finally, the research needs in ageing of embankment dams are described. It is proposed that ageing phenomena, which are difficult to detect, should be studied further in order to reach a better understanding as well as study appropriate methods for their detection. Also earlier observed ageing cases in Swedish embankment dams should be studied and reported, and methods of detecting ageing should be studied and tested. (15 refs., 10 tabs., 4 figs.).

14 SOLAR ENERGY

1401 Resources and Availability

25994 (NREL/TP–411-5013) **Photovoltaic Advanced Research and Development project: Solar radiation research annual report, 1 October 1990–30 September 1991.** Hulstrom, R.; Cannon, T.; Stoffel, T.; Riordan, C. National Renewable Energy Lab., Golden, CO (United States). Oct 1992. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-83CH10093. Order Number DE92016430. Source: OSTI; NTIS; GPO Dep.

This report is a summary of the year 1991 research activities and results under the Solar Radiation Research task of the Photovoltaic (PV) Advanced Research and Development project at the National Renewable Energy Laboratory (NREL). This task directly supports the characterization, testing, and design of PV cells modules, and systems. The development of a scientific and engineering understanding of incident (i.e., available to PV devices) solar irradiance and the appropriate instrumentation systems and measurement methods are the activities and results of this project. Activities described in this report include the completion of the Atmospheric Optical Calibration Systems (AOCS) and the comparison of instrumentation systems that collect site-specific measurements of solar irradiance for the purpose of PV system feasibility studies and/or design.

1405 Solar Energy Conversion

Refer also to citation(s) 25994, 26006, 26027, 26795, 26813, 27384, 27385, 27515

25995 (ANL/CHM/CP–79459) **Ultrafast photoinduced electron transfer reactions in supramolecular arrays: Studies of electronic coupling and solvation.** Wasielewski, M.R.; Wiederrecht, G.P.; Svec, W.A. Argonne National Lab., IL (United States).

[1993]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9306113–1: 17. solar photochemistry research conference, Brainerd, MN (United States), 6-10 Jun 1993). Order Number DE93012910. Source: OSTI; NTIS; GPO Dep.

Research in our laboratory focuses on developing supramolecular arrays that produce long-lived charge separation by limiting the electronic coupling between the separated charges, and on the role of solvation in determining the rates and energetics of photoinitiated electron transfer reactions. Arrays have been developed that closely mimic the electronic coupling that was observed only for long-lived radical pairs produced in photosynthetic glassy solids. A series of 36 fixed-distance donor-acceptor molecules using porphyrin donors, triptycene spacers, and 9 different acceptors has been prepared; these are used to probe the dependence of photoinduced charge separation rates on free energy of reaction as a function of solvent both in liquid and solid solution. Data were obtained on rates of charge separation in dioxane, MTHF, butyronitrile, toluene, chlorobenzene, and benzonitrile.

25996 (DOE/CE/15974–T4) **[Study of novel conductive paints for solar cell electromagnetic fields]: Progress report, February 24, 1993–May 1, 1993.** Soukup, R.J.; Ianno, N.J. Nebraska Univ., Lincoln, NE (United States). Dept. of Electrical Engineering. [1993]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG01-92CE15974. Order Number DE93015088. Source: OSTI; NTIS; GPO Dep.

Progress in adhesion and electric resistivity studies on paints for use as solar cell contacts is reviewed. Some results on resistivity vs. baking temperature for some paints are shown.

25997 (DOE/ER/20076–1) **Photosynthetic electron transport in genetically altered chloroplasts: Progress report, June 15, 1992–June 15, 1993.** Sayre, R.T. Ohio State Univ., Columbus, OH (United States). Jun 1993. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-92ER20076. Order Number DE93017200. Source: OSTI; NTIS; GPO Dep.

We have generated and characterized the phenotypes of several photosystem II,D1 protein mutants in Chlamydomonas reinhardtii chloroplasts. The first set of mutants which we produced were at residue H195 on the D1 protein, adjacent to histidine -198 (H198), a putative ligand to the redox active chlorophyll special pair, P680. Conservative amino acid replacements at H195 had little effect on electron transfer whereas non-conservative replacements had significant effects on electron transfer processes, particularly rates of transfer from Z to P680. In contrast, histidine 190 (H190) mutants were unable to evolve oxygen, had reduced manganese content, slower rates of charge transfer from Z to P680 and lacked the A_t thermoluminescence band. These results suggested that H190 may be a redox active histidine residue required for photoligation of manganese into the water oxidizing complex. EPR studies demonstrated that H190 does not H-bond to Z. This is in contrast to the H190 residue of the D2 protein which does H-bond to the redox active tyrosine, D. These are the first results which identify a specific histidine residue as potentially being redox active in photosystem II and have implications for the structure of the water oxidizing complex.

25998 (ETDE-IT–93-193) **Structural and electrical properties of highly conductive microcrystalline Si(P) layers.** Conte, G.; Addonizio, M.L.; Nobile, G.; Rubino, A.; Terzini, E. ENEA, Portici (Italy). Centro Ricerche Fotovoltaiche. 1992. 12p. (CONF-9210371–1: 12. international vacuum congress, The Hague (Netherlands), 12-16 Oct 1992). Order Number DE93799214. Source: OSTI; NTIS (US Sales Only).

Thin films of phosphorus doped microcrystalline Si were prepared in a glow discharge reactor starting from hydrogen diluted silane using less than 5 watts of RF power. Conductivities as high as 41 S/cm were measured on samples deposited at 210 degrees C. The discharge parameters and reactor geometry were examined in order to correlate the real dissipated RF power with the structural and electrical properties of the material. XRD, SEM, Raman spectroscopy and electrical characterization techniques were used. All the samples showed clusters that increased with film thickness, while at the same time the crystallite size changed in the range of 30-75 A.

25999 (LUNKDL-NKBK–1038-1-94-93) **Heterogeneity in Photosystem I: The domain organization of the chloroplast thylakoid membrane.** Andreasson, E. Lund Univ. (Sweden). Dept. of Biochemistry. Jan 1993. 47p. Order Number DE93500862. Source: OSTI; NTIS.

This thesis has focused on localizing the three large protein complexes responsible for the photosynthetic electron flow in the plant thylakoid membrane, i.e. Photosystem I (PSI), Photosystem II (PSII) and the cytochrome b/f complex. The intention was to localize the components in the grana and in the stroma lamellae region of the thylakoid membrane respectively. Also possible differences among protein complexes present in both regions were to be investigated. For these purposes a quantitative and reproducible disintegration and separation method was developed. Even though PSI was shown to be enriched in the stroma lamellae region of the thylakoid membrane while PSII was shown to be enriched in the grana region, the components were present in both membrane regions. It was found that not only PSII but also PSI is heterogeneous in antenna size. Light saturation curve analysis of the PSI activity and P700 photooxidation kinetics demonstrated that PSI in the grana stacks retain a 30-40% larger functional antenna size than PSI in the stroma lamellae. It was found that the cytochrome b/f complex is rather uniformly distributed between the two membrane regions with a slight enrichment in the grana region. A model of the thylakoid membrane is proposed in which the grana stacks and the stroma lamellae are more or less independent compartments within the thylakoid. The photosystems of the grana, $PSI\alpha$ and $PSII\alpha$ located in the granal periphery and the granal core respectively, are proposed to work in linear electron flow, while $PSI\beta$ in the stroma lamellae is involved in cyclic electron transport. (117 refs., 14 figs., 3 tabs.).

26000 (SAND–92-2870C) **Proposed guidelines for reporting performance of a solar dish/Stirling electric generation system.** Stine, W.B. (California State Polytechnic Univ., Pomona, CA (US). Dept. of Mechanical Engineering); Powell, M.A. Sandia National Labs., Albuquerque, NM (United States). [1992]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-930804–9: 28. intersociety energy conversion engineering conference, Atlanta, GA (United States), 8-13 Aug 1993). Order Number DE93016493. Source: OSTI; NTIS; GPO Dep.

Experimental performance data from dish/Stirling system testing can be analyzed to generate a system performance model. An approach to developing an experimentally based performance model of a dish/Stirling system is given. Two methods for analyzing the experimental data are described. To provide information that will permit comparison of dish/Stirling systems, it is necessary to define many of the details involved in calculating system performance data such as the net system output and system solar-to-electric efficiency. This paper describes a set of guidelines for these calculations, based on past experience, especially with the Vanguard dish/Stirling system. Also presented are a set of rating conditions at which a maximum value for system efficiency can be calculated. Comparison between systems of their rated peak solar-to-electric efficiency is made possible when these rating conditions are in common use by manufacturers and testing agencies.

26001 (SAND–92-2872C) **Emitter Wrap-Through solar cell.** Gee, J.M.; Schubert, W.K.; Basore, P.A. Sandia National Labs., Albuquerque, NM (United States). [1992]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-930540–3: 23. Institute of Electrical and Electronics Engineers (IEEE) photovoltaic specialists conference, Louisville, KY (United States), 10-14 May 1993). Order Number DE93014996. Source: OSTI; NTIS; GPO Dep.

The authors present a new cell concept (Emitter Wrap-Through or EWT) for a back-contact cell. The cell has laser-drilled vias to wrap the emitter on the front surface to contacts on the back surface and uses a potentially low-cost process sequence. Modeling calculations show that efficiencies of 18 and 21% are possible with large-area solar-grade multi- and monocrystalline silicon EWT cells, respectively.

1406 Photovoltaic Power Systems

26002 (DOE/CH/10093–190) **Photovoltaics: Program overview, fiscal year 1992.** National Renewable Energy Lab., Golden, CO (United States). Mar 1993. 39p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-83CH10093. Order Number DE93000055. Source: OSTI; NTIS; GPO Dep.

The US DOE's Photovoltaics program has helped photovoltaic technologies evolve from materials and concepts in the laboratories to competitive products rolling off automated assembly lines. This document is divided into the following sections: 1992 PV program accomplishments, expanding markets for photovoltaic systems, developing today's systems with utilities and industry, working with industry to advance the technology, cooperative research to improve materials and devices, selected achievements in cooperative R and D, and PV program services. Figs, tabs.

26003 (DOE/FTR–93012119) **[Travel to Guatemala to discuss plans to incorporate renewable energy technologies into rural electrification programs]: Foreign trip report, September 16, 1992–October 7, 1992.** Harcourt, M.M. II. Sandia National Labs., Albuquerque, NM (United States). 16 Oct 1992. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93012119. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Mr. Max Harcourt visited Guatemala City and Antigua, Guatemala. In Guatemala City, he met with the staff of the National Rural Electric Cooperative Association Central American Rural Electrification Support (NRECA/CARES) program, representatives of the United States Agency for International Development (US AID), representatives of the Ministry of Energy and Mines (MEM), and with the members of a Renewable Energy (RE) Working Group (WG) comprised of a Guatemalan utility (EEGSA), the University del Valle, and NRECA/CARES. The REWG has finalized plans for a village project using photovoltaics for lighting and water pumping and is proceeding with the project. The Ministry of Energy and Mines is still interested in a protocol of cooperation between them and the US agencies involved with renewable energy (DOE, the DAC, ECRE, and NRECA). A final draft of the protocol was reviewed on October 6, 1992, and is being staffed with the principle agencies. Discussions with US AID indicated a desire to create a regional renewable energy office in Guatemala City for the purpose of aiding and coordinating US efforts to identify and develop appropriate uses of RE technology and markets for US products in support of those projects. The REWG and NRECA were extremely pleased with the PV and Wind training held by the DAC in New Mexico in August 1992 and consider the project to have been a success. Further training opportunities were discussed and are being developed. In Antigua, Mr. Harcourt attended two weeks of intensive Spanish language training.

26004 (ETDE/JP-mf–93798905) **Prospect on new energies.: Photovoltaic power generation.** Institute of Applied Energy, Tokyo (Japan). Mar 1991. 24p. (In Japanese). Order Number DE93798905. Source: OSTI; NTIS; Available from The Institute of Applied Energy, 14-2, Nishishinbashi 1-chome, Minato-ku, Tokyo, Japan.

This paper reports surveys on photovoltaic power generation carried out by the General Energy Engineering Research Institute of Japan. Solar cells have been used already in hand-held calculators and traffic signals, and as power source to storage pumps in developing countries. Although the solar cell manufacturing cost has fallen largely, the cells could not be used practically unless the current high cost could be reduced by several fractions. Cost reduction in ancillary devices is also required. Silicon cells subjected to research works include monocrystalline, polycrystalline, and amorphous types, which are all under research for improvement. Its features may include limitless resource availability, high quality, no need of transporting and storing fuels, no generation of noise and harmful substances, long life, easy maintenance, capability of unattended operation, and constant generation efficiency regardless of plant sizes. Drawbacks lie in considerably low energy density in the solar beam, a necessity of inverters for the alternating current applications, and high cost under the present circumstances. A solar cell with a conversion efficiency of 30% has been announced in the U.S.A. 3 refs., 16 figs., 2 tabs.

26005 (PSI–126) **Albedo measurements and system investigation of a grid-connected photovoltaic plant on Mount Titlis.** Brack, M. (Paul Scherrer Inst. (PSI), Villigen (Switzerland)); Wuillemin, D.; Durisch, W. Paul Scherrer Inst. (PSI), Villigen (Switzerland). May 1993. 62p. (In German). Order Number DE93505269. Source: OSTI; NTIS.

In 1988, at Titlis-Stand, an intermediate station on the cable railway 2,450 metres above sea level, a system-interconnected 2.4 kW photovoltaic installation was put into operation. At the request of the Federal Office of Energy, a detailed analysis of the whole installation has been under way for three-and-a-half years, carried out by the Paul Scherrer Institute since January 1989. The radiation reflected by the snow and soil and its effect on energy production were of particular interest. The report gives a summary of the results of the measuring work. figs., tabs., 21 refs.

26006 (SAND–92-2829C) **Recent advances in outdoor performance evaluation of PV systems.** Quintana, M.A. (Sandia National Labs., Albuquerque, NM (US)); King, D.L.; Cannon, J.E.; Woodworth, J.R.; Boyson, W.E.; Adams, N.P.; Ellibee, D.E. Sandia National Labs., Albuquerque, NM (United States). [1992]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-930540–2: 23. Institute of Electrical and Electronics Engineers (IEEE) photovoltaic specialists conference, Louisville, KY (United States), 10-14 May 1993). Order Number DE93015031. Source: OSTI; NTIS; GPO Dep.

Sandia's Photovoltaic Technology Laboratory (PTEL) routinely performs outdoor tests of a variety of one-sun and concentrator PV modules. The authors experience is that while outdoor testing has its own set of problems, it can produce results that are more directly applicable to "field" conditions than testing in solar simulators. They have recently improved both the hardware and software at the PTEL to improve their accuracy and to deal with the special set of problems encountered in outdoor testing. Improvements in hardware include a computer-controlled solar tracker that allows us to test arrays up to 21 m^2 in size; infrared imaging of modules; and electronic loads that allow us to test components with outputs up to 1,800 watts. Improvements in software include real-time monitoring of data collection; a relational data base that has improved the reliability of test setups, operations and analyses; and a standardized reporting process that relates module performance to a number of environmental parameters.

1407 Solar Thermal Power Systems

26007 (SAND–93-0229C) **High heat flux engineering in solar energy applications.** Cameron, C.P. Sandia National Labs., Albuquerque, NM (United States). 1993. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-930722–4: Annual meeting of the Society of Photo-Optical Instrumentation Engineers (SPIE), San Diego, CA (United States), 11-16 Jul 1993). Order Number DE93016500. Source: OSTI; NTIS; GPO Dep.

Solar thermal energy systems can produce heat fluxes in excess of 10,000 kW/m^2. This paper provides an introduction to the solar concentrators that produce high heat flux, the receivers that convert the flux into usable thermal energy, and the instrumentation systems used to measure flux in the solar environment. References are incorporated to direct the reader to detailed technical information.

1409 Solar Thermal Utilization

Refer also to citation(s) 26025, 26501

26008 (DOE/FTR–93012601) **Travel to Norway to participate in the 2nd planning meeting of the International Energy Agency (IEA) Solar Heating and Cooling Program (SHCP) Task 19, solar air systems for buildings: Foreign trip report, June 28–July 2, 1992.** Anderson, R. National Renewable Energy Lab., Golden, CO (United States). 12 Oct 1992. 101p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-83CH10093. Order Number DE93012601. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Twelve experts from seven countries traveled to Norway to participate in the 2nd planning meeting of the International Energy Agency (IEA) Solar Heating and Cooling program (SHCP) Task 19 - Solar Air Systems for Buildings. The Task Leader, Robert Hastings, Switzerland, chaired the meeting and reported on the IEA Executive Committee meeting which will take place in October 1992. He also reported on the status of planning for the task. Technical presentations were made by each country, summarizing current projects and future research activities. The next meeting of task participants will be held March 1, 1993 in Milan. Handouts on solar buildings are included.

26009 (DOE/FTR–93012811) **[A meeting in Belgium on solar retrofitting]: Foreign trip report, August 31–September 2, 1992.** Lorand, R. National Renewable Energy Lab., Golden, CO (United States); Science Applications International Corp., McLean, VA (United States). 12 Oct 1992. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-83CH10093. Order Number DE93012811. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Information on solar retrofitting in seven countries is summarized briefly. Efforts to define cooperative activities are described.

26010 (DOE/SF/16306–36) **Colorado State University program for developing, testing, evaluating and optimizing solar heating and cooling systems: Project status report, March–May 1993.** Colorado State Univ., Fort Collins, CO (United States). Solar Energy Applications Lab. Jun 1993. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-86SF16306. Order Number DE93016018. Source: OSTI; NTIS; GPO Dep.

Results of heat loss tests for the Integral Collector Storage unit are shown. Work on unique solar system components is summarized briefly.

26011 (ETSU-S–1160/16) **Solar building study. Final report: Cedargrove House, Chorley.** Solar Building Study. Hobday, R.A.; Pane, G.; Palmer, J.; Shaw, P. Databuild, Birmingham (United Kingdom). Mar 1992. 105p. Order Number DE93504498. Source: OSTI; NTIS (US Sales Only).

Work performed under the Energy Performance Assessments (EPA) Project.

This study is part of the Energy Performance Assessments Project sponsored by the Energy Technology Support Unit on behalf of the UK Department of Energy. The project aims to accelerate the uptake of low energy and passive solar design of buildings, through the use of field trials to assess energy, cost and amenity issues in occupied low energy passive solar buildings. The buildings chosen cover the range of UK latitudes and climates. Cedargrove House is a four bedroom detached, two storey house near Chorley, Lancashire. It has a two storey conservatory extending from the south facade. The total annual fuel use of 23320 kWh was low for a four bedroom dwelling. The space heating fuel requirement was 85 kWh/m^2 of gross floor area. The solar gain from the conservatory and south facing glazing can displace up to 25% of the heat required from the space heating system. The design of the house succeeded in providing a thermally comfortable and visually attractive environment and was well like by the occupants. The house cost 10% more to build than an equivalent non-solar house. This is attributable to the additional cost of the conservatory which provided valuable extra space and amenity benefits. (author)

26012 (ETSU-S–1160/18) **Solar building study. Final report: The Brune Park Sports Hall, Gosport.** Solar Building Study. Watkins, R.; Seager, A.; Palmer, J.; Shaw, P. Databuild, Birmingham (United Kingdom). Mar 1992. 121p. Order Number DE93504815. Source: OSTI; NTIS (US Sales Only).

Work performed under the Energy Performance Assessments (EPA) Project.

The energy performance assessment of Brune Park school's sports hall indicated that total annual delivered fuel, normalized for long term weather at the site, is moderately low at 195 kWh of delivered energy per m^2 gross floor area. Daylight has displaced 40% of the annual electricity used for lighting. The large saving in energy has been achieved without automatic lighting controls. The building is too warm for most of the year; the heating system is set too high and there is no significant means of rejecting unwanted solar heat. The poor air quality and lack of ventilation were complained of by users. The overall cost of the building is average for sports and recreational centres. The passive solar features have been incorporated at no extra cost. (author)

26013 (ETSU-S–1160/19) **Solar building study. Final report: The Mountbatten Sports Hall, Romsey.** Solar Building Study. Watkins, R.; Palmer, J.; Seager, A.; Shaw, P. Databuild, Birmingham (United Kingdom). Mar 1992. 115p. Order Number DE93504497. Source: OSTI; NTIS (US Sales Only).

Work performed under the Energy Performance Assessments (EPA) Project.

This study is part of the Energy Performance Assessments project sponsored by the Energy Technology Support Unit on behalf of the UK Department of Energy. The project aims to accelerate the uptake of designs of low energy passive solar buildings through field trials, to assess energy, cost and amenity issues in occupied low energy passive solar buildings. The buildings chosen cover the range of UK latitudes and climates. The distinctive passive feature of the Mountbatten Sports Hall at Ramsey, in Hampshire, is the extensive daylighting by means of roof lights. Daylight has displaced 21% of the annual electricity used for lighting by daytime adult use of the hall. The design has the potential to save twice this with better automatic lighting controls. Over-heating was not a significant problem. Recommended temperatures were exceeded, but few users complained of over-heating and this was only in the summer. Air quality was acceptable. Daylight alone provided poorer illumination at the centre of the hall than towards the edges. This reduced visibility at the centre of play. The overall cost of the building was slightly below the average for this type of recreational building. The roof-lights added 6,800 pounds to the cost, but enable 1,400 pounds of electricity to be saved per year for typical hours of use. (author)

26014 (ETSU-S–1160/21) **Solar building study. Final report: Paxton Court House, Sheffield.** Solar Building Study. Hobday, R.A.; Pane, G.; Palmer, J.; Brown, J.; Shaw, P. Databuild, Birmingham (United Kingdom). Mar 1992. 109p. Order Number DE93504499. Source: OSTI; NTIS (US Sales Only).

Work performed under the Energy Performance Assessments (EPA) Project.

This study is part of the Energy Performance Assessments Project sponsored by the Energy Technology Support Unit on behalf of the UK Department of Energy. The project aims to accelerate the uptake of low energy and passive solar design of buildings, through the use of field trials assess energy, cost and amenity issues in occupied low energy passive solar buildings. The buildings chosen cover the range of UK latitudes and climates. The house at Paxton Court in Sheffield is semi-detached with three bedrooms, loft and cellar. The main passive solar feature, is a conservatory running the full length of the south west facade and covering the ground and first floor. Total annual fuel use was estimated at 21277 kWh. Of this some 153 kWh/m^2 GFA was used for space heating, providing comfortable internal temperatures. This is a reasonable performance. Solar performance was promising with estimated solar gains of 1967 kWh over the heating season. This is equivalent to 20% of the space heating energy used. The occupants were very satisfied with the levels of comfort achieved in the house. The design was considered successful in all respects and it sold quickly when placed on the market. The house cost 9% more to build than an equivalent non-solar house. This can mainly be attributed to the cost of the conservatory which was skillfully integrated into the overall design. For the additional cost the conservatory provided energy and amenity benefits and an increase in floor space over the reference. (author)

26015 (ETSU-S–1160/26) **Solar building study. Final report: Christopher Taylor Court, Bournville, Birmingham.** Solar Building Study. Watkins, R.; Palmer, J.; Shaw, P.; Pane, G. Databuild, Birmingham (United Kingdom). Mar 1992. 113p. Order Number DE93504496. Source: OSTI; NTIS (US Sales Only).

Work performed under the Energy Performance Assessments (EPA) Project.

The Energy Performance Assessments project sponsored by the Energy Technology Support Unit on behalf of the Department of

Energy aims to accelerate the uptake of designs of low energy passive solar buildings through field trials to assess energy, cost and amenity issues in occupied low energy passive solar buildings. The buildings chosen cover the range of UK latitudes and climates. Christopher Taylor Court is a sheltered housing scheme for elderly people at Bournville, Birmingham. It consists of flats most of which have the living and bedroom windows facing south, with their north sides adjoining a corridor. The south facades incorporate glazed uninsulated walls with a selective surface to absorb solar energy. Total annual delivered fuel is 292 kWh per m^2 gross floor area. This is high for a building that is very well insulated. The building is unnecessarily warm; corridors are often at 25°C (the design temperature was 16°C); thermostats in most flats are set to 25°C or above. Poor control over the use of space heating has led to conditions which have almost obscured the impact of solar gain on the building. The mass walls have performed better than the well-insulated cavity walls used. They reduced heat loss by 25% during October to April. Detailed monitoring has suggested that solar gain contributes 5% of all the energy used to heat a flat. The total building cost was near the mean of a sample of similar reference buildings. Sliding doors and mass walls cost 17,000 pounds extra for the site. (author)

26016 (ETSU-S–1160/27) **Solar building study. Final report: Cockerell Grove House, Milton Keynes.** Solar Building Study. Hobday, R.A.; Pane, G.; Seager, A.; Palmer, J. Databuild, Birmingham (United Kingdom). Mar 1992. 106p. Order Number DE93504813. Source: OSTI; NTIS (US Sales Only).

Work performed under the Energy Performance Assessments (EPA) Project.

The results of an energy performance assessment carried out on the Cockerell Grove house are presented. The total measured annual fuel use of 16206 kWh, or 207 kWh/m^2 gross floor area, was low as was the space heating fuel use at 5762 kWh, or 74 kWh/m^2 gross floor area. Solar performance resulted in a measured solar contribution of 936 kWh, or 619 kWh for a typical year, from a combination of south facing glazing and a roofspace solar collector. The house was built for 5% more than an equivalent non-solar house of the same size, built to the same insulation standards. This cost difference can be attributed largely to the roof-space solar collector. The occupants liked the levels of daylight and impression of spaciousness created by the glazing on the south of the house. The combination of roof-space collector and heat recovery unit, as configured in the Cockerell Grove House, compromised the solar performance. (author)

26017 (ETSU-S–1160/30) **Solar building study. Final report: Britannia House, Hoylake.** Solar Building Study. Seager, A.; Evans, R.; Palmer, J.; Minikin, J. Databuild, Birmingham (United Kingdom). Mar 1992. 125p. Order Number DE93504812. Source: OSTI; NTIS (US Sales Only).

Work performed under the Energy Performance Assessments (EPA) Project.

An energy performance assessment was carried out to an old laundry that had been refurbished to form a new office building. Results indicated that the total annual fuel use for the building was reasonable at 271kWh/m^2 GFA, of which almost half was electricity. This includes the air conditioning plant which was used to maintain comfort conditions through the year. The refurbishment was successful in producing a design with passive solar potential, however a lack of consideration to controls meant that the potential was largely unrealised. Solar Gains contributed 8% of the buildings total heating requirement. The office is well liked by most occupants who rated it as pleasant and likeable. The refurbishment cost was estimated at 643/m^2 pounds, however higher insulation standards could have been incorporated at little additional cost. (author)

26018 (ETSU-S–1163/29) **Solar building study. Final report: Albert Hall Memorial Housing, Coalville, Leicestershire.** Solar Building Study. Vaughan, N.; Jones, P.; Alexander, D.; Jenkins, H.; Fedeski, M.; Lannon, S. University of Wales Coll. of Cardiff (United Kingdom). Welsh School of Architecture. Jan 1992. 131p. Order Number DE93504814. Source: OSTI; NTIS (US Sales Only).

Work performed under the Energy Performance Assessments (EPA) Project.

The main components of an energy performance assessment (EPA) of this sheltered housing involved measured energy; modelled energy; reference energy; measured amenity and environment, and operator study; modelled cost; and reference cost. The total annual fuel use of 12403 kWh was found to compare very well with that of a well insulated non-solar design. This good energy performance is due principally to the building's well scaled and insulated envelope, rather than to its passive design. (author)

26019 (ETSU-S–1219-P4) **BREDEM-8 parametric study into the potential energy saving from passive solar house design.** Orrell, R. NBA Tectonics, London (United Kingdom). Dec 1992. 16p. Contract E/5 CON 1219/1849. Order Number DE93504799. Source: OSTI; NTIS (US Sales Only).

Passive solar can help to realise energy savings in housing through a conscious intent to make optimum use of the free energy available from the sun. By designing for increased solar utilisation the demands on the conventional heating system can be reduced. The designer needs to consider both the design of the house (the glazing area, its distribution around the facades and the internal arrangement of rooms) as well as the site design (the orientation of houses for maximum solar gains into the rooms with the greatest heating demand and the positioning of houses within their plots for minimal overshadowing). (author)

26020 (ETSU-S–1352) **Evaluation of passive solar potential multi-residential dwellings and domestic retrofit measures.** Bown, H. NBA Tectonics, London (United Kingdom). 1993. 110p. Order Number DE93504518. Source: OSTI; NTIS (US Sales Only).

A number of measures are identified from which a total energy saving of 40.7 PJ might be realised by the year 2030, of which 32.6 PJ is accounted for by one large measure. The potential is defined as the potential which might be achieved by encouragement from the passive solar programme over and above what will be achieved in the natural course of events without that encouragement. Attention is drawn to current interest in transparent insulating materials. They raise technical issues now being investigated, but if the technical problems can be overcome and costs significantly reduced they may have great potential in retrofit measures. (Author)

26021 (ETSU-S–1362) **House design studies: Overview.** Boss, A.; Orbasli, A.; Sutcliffe, S. York Univ. (United Kingdom). Inst. of Advanced Architectural Studies. Dec 1992. 300p. Contract E/5A/1362/2715. Order Number DE93504517. Source: OSTI; NTIS (US Sales Only).

The results documented in this overview are based on reports of 43 passive solar house designs. The designs were commissioned by the Energy Technology Support Unit (ETSU) as part of the Department of Trade and Industry Passive Solar Programme. Each report is a study of three houses and their relative energy performance as modelled using the thermal simulation programme SERI-RES. The three are a designed passive solar house, a standard developer's house of equivalent size and accommodation and built to 1990 Building Regulation thermal standards, and the same developer's house but with the level of fabric insulation increased to the same specification as the designed passive solar house. The standard developer's house, in both its forms, is provided as a point of comparison for the design house. The results of this study fall broadly into two groups: those which relate to the energy performance of the designs and those which relate to the commercial acceptability of the designs. (Author)

26022 (NEI-DK–1213) **Solar heating system for space heating and domestic water supply: "Ans solvarme". Validation of KVIKSOL.** Nielsen, J.E. Dansk Teknologisk Inst., Taastrup (Denmark). Proevestationen for Solenergi. Mar 1992. 45p. (In Danish). Contract TR-87.080. Order Number DE93500369. Source: OSTI; NTIS.

Measurements from a solar heating system for space heating and heating of domestic hot water using calculations carried out by a computer programme designated "KVIKSOL" are presented. The system comprises a solar collector measuring 13 cubic meters and storage capacity of 650 liters. The programme proved to be satisfactory. Variations of design and consumption were investigated and some rules for dimensioning this type of system were set up. These are that there ought to be a need for space heating during

the summer and/or a need for hot water of at least 20 liters daily per square meter of solar collector. Regarding the area of the solar collector, 1 square meter should give 2000 kWh annually (total consumption), the angle of the collector should be 50-60 degrees and the storage volume should be 40-50 liters per square meter solar collector. If these rules are followed in relation to the described type of system the same production can be achieved per square meter solar collector and for a well dimensioned domestic water system, and at the same time a double coverage of heating needs will be gained. (AB).

26023 (NEI-DK–1220) **Operational experience of spandrel solar walls: Partial report 1: Measurements on the improved construction. Duevej in Struer.** Andersen, N.B. (Dansk Teknologisk Institut, Taastrup (Denmark)); Genborg, T.; Falck, U. Dansk Teknologisk Inst., Taastrup (Denmark). Energiteknologi; Talck's (U.) Tegnestue, Frederiksberg (Denmark). Mar 1992. 19p. (In Danish). Contract ENS-51181-91.0007. Order Number DE93500319. Source: OSTI; NTIS.

The existing and the planned altered construction of a spandrel wall in which the solar walls are integrated in a house situated in Struer, Denmark are evaluated in addition to the absorbent materials used. The protective measures against the occurrence of too high temperatures are described. The results of the temperature measurements are included. (AB).

26024 (NEI-DK–1221) **Operational experience of spandrel solar walls: Partial report 2: Evaluation of energy yield for solar walls that preheat fresh air. Duevej in Struer.** Andersen, N.B. (Dansk Teknologisk Institut, Taastrup (Denmark)); Genborg, T.; Falck, U. Dansk Teknologisk Inst., Taastrup (Denmark). Energiteknologi; Talck's (U.) Tegnestue, Frederiksberg (Denmark). May 1992. 25 p.p. (In Danish). Contract ENS-51181-91.0007. Order Number DE93500325. Source: OSTI; NTIS.

Alterations had made in the construction of the spandrel solar walls and protective measures against overheating of the construction had been taken in a house situated in Struer, Denmark. Measured data on temperature, energy yields, costs etc. are presented and evaluated. Stagnation temperatures are also given. A computer programme for the calculation of the heating yield is described and an evaluation of capacity based on air volume flow measurements in the solar wall is presented. (AB).

1410 Solar Collectors and Concentrators

Refer also to citation(s) 26010

26025 (NREL/TP–471-5536) **Reflective coatings for solar applications.** Jorgensen, G. National Renewable Energy Lab., Golden, CO (United States). May 1993. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-83CH10093. (CONF-9304149–1: 36. annual Society of Vacuum Coaters technical conference, Dallas, TX (United States), 27-29 Apr 1993). Order Number DE93010026. Source: OSTI; NTIS; GPO Dep.

Many applications of solar energy require large mirrors to provide high levels of concentrated sunlight. The success of such conversion systems hinges on the optical durability and economic viability of the reflector materials. A major effort at the National Renewable Energy Laboratory (NREL) has been to improve the existing reflector materials technology and to identify candidates that retain optical performance and durability criteria and offer potential for reduced cost. To attain the goals, it is desirable to maintain and increase the involvement of industrial organizations in reflective materials R&D related to the conversion of solar resources to useful energy. Toward this end, NREL has recently initiated several collaborative efforts with industry to develop advanced reflector materials.

26026 (SAND–92-2789C) **Revisiting the BCS, a measurement system for characterizing the optics of solar collectors.** Strachan, J.W. Sandia National Labs., Albuquerque, NM (United States). [1992]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-930561–6: 39. international instrumentation symposium, Albuquerque, NM (United States), 2-6 May 1993). Order Number DE93015030. Source: OSTI; NTIS; GPO Dep.

The Beam Characterization System is being employed at the Sandia's National Solar Thermal Test Facility to characterize the optical performance of heliostats, point-focus solar collectors, and their optical sub-elements as part of the on-going task to develop solar thermal technologies. With this measurement system, images of concentrated solar flux are acquired using digital imaging and processed to obtain such measures of the collector's optical performance as beam power, flux distribution, and beam diameter. Key system elements are a diffusely reflective target for imaging collector beams, meteorological instrumentation including a flux gauge to measure flux at one point in the beam, and a calibration technique to establish a pixel-intensity-to-flux-density conversion factor for the image. The system is employed in a variety of collector tests such as beam quality, tracking error, and wind effects. The paper describes the Beam Characterization System and its components and presents, for illustration, sample test results. An analysis of the Beam Characterization System's sources of measurement error is presented. Lastly, measurement techniques that employ the BCS to align heliostats and to measure or estimate collector surface slope errors are described.

26027 (SAND–92-2831C) **Progress in the Concentrator Initiative Program.** Maish, A.B. Sandia National Labs., Albuquerque, NM (United States). [1992]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-930540–8: 23. Institute of Electrical and Electronics Engineers (IEEE) photovoltaic specialists conference, Louisville, KY (United States), 10-14 May 1993). Order Number DE93015006. Source: OSTI; NTIS; GPO Dep.

Progress made by the eight participating cell and collector manufacturers since the beginning of the US Department of Energy's multiyear photovoltaic Concentrator Initiative program is reviewed. Point and line-focus cell manufacturers achieved peak efficiencies between 19% and 25% with designs that could be manufactured commercially. Collector manufacturers delivered prototype hardware of point and line-focus collectors representing commercially producible technology.

15 GEOTHERMAL ENERGY

26028 (ETSU-R–59) **Geothermal hot dry rock: UK Government R and D programme 1976-1991.** AEA Environment and Energy, Harwell (United Kingdom). 1992. 108p. Order Number DE93503573. Source: OSTI; NTIS (US Sales Only).

The Energy Technology Support Unit has been responsible since 1976 for the management of the UK Government's R and D Programme on geothermal hot dry rock, funded through the Department of Energy's Renewable Energy Programme. The aim has been to assess the technical and economic feasibility of the hot dry rock concept for commercial application and to conduct a full scale field trial, in collaboroation with industry, by the mid 1990s. Teams engaged on this work were from university, polytechnic, industry and government research laboratories, supported by engineering contractors and consultants. The Programme to date has cost 42M pounds, of which the Commission of the European Communities has contributed 3M pounds. Details of the work are available in many reports and are reviewed in this document. They show that the geological and other factors involved in the creation of hot dry rock electricity generating systems are now much better understood and the size and distribution of the resource has been established. There has also been a major increase in knowledge of the relevant economic and risk factors which has shown that the early promise of the technology is unlikely to be fulfilled in the UK in the short or medium term. The main experimental work for the R and D Programme was carried out at Rosemanowes Quarry, near Falmouth in Cornwall, by the Camborne School of Mines. (author)

1501 Resources and Availability

Refer also to citation(s) 26551, 26552

26029 (LA-UR–93-1678) **Hot Dry Rock energy annual report fiscal year 1992.** Winchester, W.W. (ed.); Duchane, D.V. Los

Alamos National Lab., NM (United States). Apr 1993. 80p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93014452. Source: OSTI; NTIS; INIS; GPO Dep.

Hot Dry Rock technology took a giant leap forward this year as the long-awaited long-term flow test (LTFT) of the Phase 2 HDR reservoir at Fenton Hill got underway. Energy was produced on a twenty-four hour a day basis for a continuous period of nearly four months of steady-state testing. Hot water was brought to the surface at 90–100 gallons per minute (gpm) with temperatures of 180°C (356°F) and higher. During that time, the HDR plant achieved an on-line record of 98.8%. Surface temperature measurements and temperature logging deep within the wellbore confirmed that no decline in the average temperature of fluid produced from the reservoir occurred. Tracer experiments indicated that flow paths within the reservoir were undergoing continuous change during the test. Remarkably, it appeared that longer flow paths carried a larger proportion of the flow as the test proceeded, while more direct fluid pathways disappeared or carried a significantly reduced flow. In sum, access to hot rock appeared to improve over the span of the test. Water losses during the test averaged 10–12% and showed a slow long-term decline. These results confirmed what had been previously discovered in static pressurization testing: Water consumption declines significantly during extended operation of an HDR reservoir. In combination with a recent demonstration by the Japanese that water losses can be greatly reduced by the proper placement of multiple production wells, the recent results at Fenton Hill have effectively demonstrated that excessive water consumption should not be an issue for a properly engineered HDR facility at a well chosen site.

1502 Geology and Hydrology of Geothermal Systems

Refer also to citation(s) 26028, 26044

26030 (EGG-EP–10787) **Generalization of vapor pressure lowering effects in an existing geothermal simulator.** Shook, G.M. EG and G Idaho, Inc., Idaho Falls, ID (United States). Jun 1993. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. Order Number DE93016635. Source: OSTI; NTIS; GPO Dep.

Thermodynamic properties of pore water are shown to be different from those of bulk water because of interfacial forces between the aqueous and solid phases. This "vapor-pressure lowering" (VPL) effect is described through Kelvin's equation, which relates VPL to properties of the liquid phase. An algorithm that accounts for VPL had previously been implented in the geothermal simulator TETRAD. This algorithm applies to a narrow range of reservoir properties, and in some cases leads in inconsistencies. This report presents a generalization of the VPL algorithm which removes many of its limitations. The governing equations for the generalization are presented, assumptions and limitations of the method are discussed, and the modifications are validated.

1503 Geothermal Exploration and Exploration Technology

Refer also to citation(s) 26038, 26051, 27217, 27664

26031 (DOE/ID/13025–10) **Experimental and theoretical investigation of the production of HCl and some metal chlorides in magmatic/hydrothermal systems: First quarterly progress report No. 10, January–March 1993.** Piccoli, P. Maryland Univ., College Park, MD (United States). 1993. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG07-90ID13025. Order Number DE93015586. Source: OSTI; NTIS; GPO Dep.

Progress in modifying a model in which the halogen (Cl and F) concentration in the mineral apatite in mid-crustal silicic plutonic systems can be used to make estimates of magmatic Cl and F concentrations at the time apatite was crystallizing is reviewed briefly. (MHR)

1505 Economic, Industrial, and Business Aspects

Refer also to citation(s) 26029, 26049, 26476

1508 Geothermal Power Plants

Refer also to citation(s) 26028, 26029, 26476

26032 (DOE/ID/12578–3-Vol.3) **Design and operation of a geopressured-geothermal hybrid cycle power plant: Appendix B-1, Pleasant Bayou Site: Final report.** Campbell, R.G.; Hattar, M.M. Eaton Operating Co., Inc., Houston, TX (United States); Holt (Ben) Co., Pasadena, CA (United States). Feb 1991. 194p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-85ID12578. Order Number DE93016253. Source: OSTI; NTIS; GPO Dep.

The following appendices are included: process flow diagram, piping and instrumentation diagram, new equipment specifications, main single line diagram, shutdown and start-up procedures, data sheets for tests, plant outages, detailed process equations, computer program and sample output, chemical analysis and scanning electron microscopy results, and management report data sheets for January 5, 1990 to May 29, 1990. (MHR)

26033 (ETDE/JP-mf–93799057) **No.30 survey report on promotion of geothermal energy development in 1991.: Survey of environmental effects of fumarolic gas in the Hakkodo area.** New Energy and Industrial Technology Development Organization, Tokyo (Japan). Jan 1993. 31p. (In Japanese). Order Number DE93799057. Source: OSTI; NTIS; Available from New Energy and Industrial Technology Development Organization, Sunshine 60, 30F 1-1, 3-chome, Higashi-Ikebukuro, Toshima-ku, Tokyo, Japan.

The paper investigates how hot springs are affected by drilling of environmental survey wells and blowout/injection of geothermal fluids which are incidental to the geothermal energy development in the Hakkoda west area. Hot springs for survey are classified as follows: Sukayu hot springs; acidity-containing Al-Ca-SO4 spring, Jogakura No.2 spring, Na-HCO3·Cl-SO4 type simple spring, Jogakura No.3 spring; alcaline/Na-HCO3 type simple spring, Kansuizawa hot spring; Na-HCO3, Cl spring. As compared with the environmental survey in fiscal 1989 before blowout, the hot springs except Jogakura No.3 spring were relatively smaller in variations and brought almost stabilized results. Moreover, large variations in each survey item relating to Jogakura No.3 spring agreed with those at the time of stopping pumping facilities due to reduction in output of hot water, and it is hard to think that it was caused by drilling of geothermal exploratory wells. Accordingly, there are seen no effects of drilling for geothermal exploration on the neighboring hot springs. For geothermal survey, however, it is desirable to investigate hydrologic structures and then to take measures such as injection of all geothermal water into the depth of the underground. 4 refs., 13 figs., 7 tabs.

26034 (ETDE/JP-mf–93799058) **No.31 survey report on promotion of geothermal energy development in 1991.: Survey of environmental effects of fumarolic gas in the Iwatesan west area.** New Energy and Industrial Technology Development Organization, Tokyo (Japan). Jan 1993. 37p. (In Japanese). Sponsored by New Energy and Industrial Technology Development Organization, Tokyo (Japan). Order Number DE93799058. Source: OSTI; NTIS; Available from New Energy and Industrial Technology Development Organization, Sunshine 60, 30F 1-1, 3-chome, Higashi-Ikebukuro, Toshima-ku, Tokyo, Japan.

The paper investigates hot springs in fumarolic gas in the Iwatesan west area, and evaluates effects of regional development on the neighboring environment. Details of each spring are as follows: PH, total evaporation residue, and quality of spring are 7.8, 2190mg/l, and Ca·Mg-HCO3·SO4 spring for Water well No.18; 7.4, 1285mg/l, and Na-HCO3· Cl spring for Genbu hot spring; 7.6, 471mg/l, and Na·Ca-HCO3 type simple spring for Nukumori hot spring; 2.9, 461mg/l, and acidity-Ca-SO4 type simple spring for Matsukawa hot spring, respectively. Variations are smaller than those in fiscal 1989. Only Matsukawa hot spring is large in variation in output of hot water, but a coefficient of its correlation with precipitation is 0.38. Anyhow, when installing a geothermal power

plant, it is necessary to make investigations on injection of geothermal water into the underground, hydrologic structures, etc. and to give careful consideration to the effect of the development on sources of hot spring. 6 refs., 6 figs., 8 tabs.

26035 (ETDE/JP-mf–93799059) **No.36 survey report on promotion of geothermal energy development in 1991.: Survey of environmental effects before fumarolic gas in the Amemasudake area.** New Energy and Industrial Technology Development Organization, Tokyo (Japan). Jan 1993. 200p. (In Japanese). Sponsored by New Energy and Industrial Technology Development Organization, Tokyo (Japan). Order Number DE93799059. Source: OSTI; NTIS; Available from New Energy and Industrial Technology Development Organization, Sunshine 60, 30F 1-1, 3-chome, Higashi-Ikebukuro, Toshima-ku, Tokyo, Japan.

The paper investigates hot springs in fumarolic gas in the Amemasudake area, and evaluates effects of regional development on the neighboring environment. At all inspection points, volumes of H2S, SO2 and suspended particulate are below detection limit values. Hg is detected by 0.015μg/m^3, which is not so high as compared with measuring data obtained in the geothermal zone. Water quailty of the rivers at each point is a little bit high in BOD, but good. For installation of the geothermal power plant, it is necessary to take measures to eliminate effects on quality of river water such as proper treatment of drilled soil/sludge and injection of geothermal water into the underground. It is considered that installation of the geothermal power plant produces no large effects on environments for growth/inhabiting of plants and animals, but it is desired to give consideration to the development such as making the deforestation area necessary and minimum. Measures aiming at harmony with forest landscape should be taken for installation of the plant. It is necessary to conduct investigations on water quality and hydrologic structures and to give careful consideration to the effect of production and underground injection of geothermal fluids on the existing hot springs. 16 refs., 44 figs., 53 tabs.

26036 (ETDE/JP-mf–93799060) **No.37 survey report on promotion of geothermal energy development in 1991.: Survey of environmental effects before fumarolic gas in the Hongu area.** New Energy and Industrial Technology Development Organization, Tokyo (Japan). Jan 1993. 189p. (In Japanese). Sponsored by New Energy and Industrial Technology Development Organization, Tokyo (Japan). Order Number DE93799060. Source: OSTI; NTIS; Available from New Energy and Industrial Technology Development Organization, Sunshine 60, 30F 1-1, 3-chome, Higashi-Ikebukuro, Toshima-ku, Tokyo, Japan.

The paper investigates effects of geothermal energy exploration activities on the environment in the Hongu area, and evaluates the present status of environmental factors necessary before the development. H2S, CO2 and Hg are not detected at all, and suspended particulate is 217-488μg/m^3, which is higher than the environmental standard of suspended particulate matters. At all survey points, water quality is on the same level as that of general rivers. As environmental indices, 25 biological species are recognized. With regard to the landscape of the survey area, beautiful fresh verdure is viewed in spring, but colored levels are hardly seen in fall because there are many evergreen conifers. Among spring sources, Tamanoyu, Tatsunoyu and Oguriyu are a self-erupting spring, and Shigenoyu, Fujiyu and Iimori spring source are a pumping spring. Those are 66-92°C in spring temperature and 16-300l/min in output of hot water, and 6.8-7.7 in PH which is alkalescent. Quality of the spring is Na-HCO3-Cl. They are small in variations and relatively stable. Since sources of each spring is thought to exist in the shallow underground, it is desired to inject hot water into the underground for geothermal development. 13 refs., 39 figs., 57 tabs.

26037 (ETDE/JP-mf–93799061) **No.38 survey report on promotion of geothermal energy development in 1991.: Survey of environmental effects before fumarolic gas in the Mt. Aso west area.** New Energy and Industrial Technology Development Organization, Tokyo (Japan). Jan 1993. 211p. (In Japanese). Sponsored by New Energy and Industrial Technology Development Organization, Tokyo (Japan). Order Number DE93799061. Source: OSTI; NTIS; Available from New Energy and Industrial Technology Development Organization, Sunshine 60, 30F 1-1, 3-chome, Higashi-Ikebukuro, Toshima-ku, Tokyo, Japan.

The paper evaluates effects of geothermal energy exploration activities on the environment in the Mt. Aso west area. At survey points, H2S and SO2 are detected. Hg is 0.002-0.038μg/m^3. Quality of river water is pure at each point. Most of the survey area is occupied by substitutional community like grassland, afforestation, etc. For geothermal development, it is necessary to pay attention to protection of regions where natural vegitation is distributed and to make the deforestation area necessary and minimum. If the geothermal power plant is installed, it contributes further to the region in terms of employment and finance based on the development of the local industry. It is estimated that the five hot springs surveyed are formed by heating of the ground water which originates in rain water or heating of the meteoric water which permeates the underground, by means of vapor containing CO2 and H2S. For the development, it is necessary to take measures to inject all output of geothermal water into the deep underground. 20 refs., 43 figs., 54 tabs.

1509 Geothermal Engineering

Refer also to citation(s) 26476, 26604

26038 (DOE/CE–0397) **Geothermal Reservoir Technology Research Program: Abstracts of selected research projects.** Reed, M.J. (ed.). USDOE Assistant Secretary for Energy Efficiency and Renewable Energy, Washington, DC (United States). Mar 1993. 142p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93016323. Source: OSTI; NTIS; GPO Dep.

Research projects are described in the following areas: geothermal exploration, mapping reservoir properties and reservoir monitoring, and well testing, simulation, and predicting reservoir performance. The objectives, technical approach, and project status of each project are presented. The background, research results, and future plans for each project are discussed. The names, addresses, and telephone and telefax numbers are given for the DOE program manager and the principal investigators. (MHR)

26039 (DOE/FTR–93012409) **[Travel to Russia and the UK concerning mining and heat extraction technology]: Foreign trip report, September 11–24, 1992.** Kruger, P. (Stanford Univ., CA (United States)). Sandia National Labs., Albuquerque, NM (United States). 30 Sep 1992. 65p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93012409. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Meetings with groups interested in geothermal resource development in Russia and the United Kingdom are reviewed.

26040 (DOE/ID/12578–3-Vol.1) **Contractor for geopressured-geothermal sites: Final contract report, Volume 1, fiscal years 1986–1990 (5 years), testing of wells through October 1990: Appendix A, Volume 2, Gladys McCall Site (Cameron Parish LA); Appendix B-1, Volume 3, Pleasant Bayou Site; Appendix B-2, Volume 4, Pleasant Bayou Site; Appendix C, Volume 5, Willis Hulin Site.** Eaton Operating Co., Inc., Houston, TX (United States); Institute of Gas Technology, Chicago, IL (United States); Holt (Ben) Co., Pasadena, CA (United States). Sep 1992. 215p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-85ID12578. Order Number DE93016251. Source: OSTI; NTIS; GPO Dep.

Field tests and studies were conducted to determine the production behavior of geopressured-geothermal reservoirs and their potential as future energy sources. Results are presented for Gladys McCall Site, Pleasant Bayou Site, and Hulin Site.

26041 (DOE/ID/12578–3-Vol.2) **Flow tests of the Gladys McCall well: Appendix A, Gladys McCall Site (Cameron Parish, LA): Final report, October 1985–October 1990.** Randolph, P.L. (Institute of Gas Technology, Chicago, IL (United States)); Hayden, C.G.; Rogers, L.A. Eaton Operating Co., Inc., Houston, TX (United States); Institute of Gas Technology, Chicago, IL (United States). Apr 1992. 486p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-85ID12578. Order Number DE93016252. Source: OSTI; NTIS; GPO Dep.

This report pulls together the data from all of the geopressured-geothermal field research conducted at the Gladys McCall well. The well produced geopressured brine containing dissolved natural gas from the Lower Miocene sands at a depth of 15,150 to 16,650 feet. More than 25 million barrels of brine and 727 million standard cubic feet of natural gas were produced in a series of flow tests between December 1982 and October 1987 at various brine flow rates up to 28,000 barrels per day. Initial short-term flow tests for the Number 9 Sand found the permeability to be 67 to 85 md (millidarcies) for a brine volume of 85 to 170 million barrels. Initial short-term flow tests for the Number 8 Sand found a permeability of 113 to 132 md for a reservoir volume of 430 to 550 million barrels of brine. The long-term flow and buildup test of the Number 8 Sand found that the high-permeability reservoir connected to the wellbore (measured by the short-term flow test) was connected to a much larger, low-permeability reservoir. Numerical simulation of the flow and buildup tests required this large connected reservoir to have a volume of about 8 billion barrels (two cubic miles of reservoir rock) with effective permeabilities in the range of 0.2 to 20 md. Calcium carbonate scale formation in the well tubing and separator equipment was a problem. During the first 2 years of production, scale formation was prevented in the surface equipment by injection of an inhibitor upstream of the choke. Starting in 1985, scale formation in the production tubing was successfully prevented by injecting inhibitor "pills" directly into the reservoir. Corrosion and/or erosion of surface piping and equipment, as well as disposal well tubing, was also significant.

26042 (DOE/ID/12578–3-Vol.4) **Testing of the Pleasant Bayou Well through October 1990: Final report, October 1985–October 1990.** Randolph, P.L.; Hayden, C.G.; Mosca, V.L.; Anhaiser, J.L. Eaton Operating Co., Inc., Houston, TX (United States); Institute of Gas Technology, Chicago, IL (United States). Aug 1992. 487p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-85ID12578. Order Number DE93016254. Source: OSTI; NTIS; GPO Dep.

Pleasant Bayou location was inactive from 1983 until the cleanout of the production and disposal wells in 1986. The surface facilities were rehabilitated and after shakedown of the system, additional repair of wellhead valves, and injection of an inhibitor pill, continuous long-term production was started in 1988. Over two years of production subsequent to that are reviewed here, including: production data, brine sampling and analysis, hydrocarbon sampling and analysis, solids sampling and analysis, scale control and corrosion monitoring and control.

26043 (DOE/ID/12578–3-Vol.5) **Flow tests of the Willis Hulin well: Appendix C, Willis Hulin Site: Final report, October 1985–October 1990.** Randolph, P.L.; Hayden, C.G.; Rogers, L.A. Institute of Gas Technology, Chicago, IL (United States); Eaton Operating Co., Inc., Houston, TX (United States). Feb 1992. 127p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-85ID12578. Order Number DE93016255. Source: OSTI; NTIS; GPO Dep.

The Hulin well was tested between 20,100 and 20,700 feet down in layers of brine-saturated clean sand with occasional intervening layers of shale. The characteristics of the brine and gas were determined in this interval and an initial determination of the reservoir properties were made.

26044 (DOE/NV/10412–5) **Consolidated Research Program, United States Gulf Coast Geopressured-Geothermal Program: First quarterly report, January 1, 1993–March 3, 1993.** Texas Univ., Austin, TX (United States). Center for Petroleum and Geosystems Engineering. Jun 1993. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC07-85NV10412. Order Number DE93015588. Source: OSTI; NTIS; GPO Dep.

Water influx calculations for the Gladys McCall reservoir were conducted based on three commonly applied water influx models. Results are shown graphically. Work on geologic studies was summarized.

26045 (ETSU-G–151-P8) **Techniques for the correction of short circuit effects on HDR reservoirs: Camborne Geothermal Energy Project.** Parker, R.H. (ed.). Camborne School of Mines (United Kingdom). Geothermal Energy Project. 1992. 117p. Order Number DE93504501. Source: OSTI; NTIS (US Sales Only).

A flow path, or a combination of flow paths, which results in preferential flow through a specific region of a hot-dry-rock (HDR) reservoir, will lead to premature thermal drawndown. Methods of handling such short circuits have been the objective of the work at the Rosemanowes reservoir, Cornwall, UK, covered by this report. Active seismic surveys, cross-hole resistivity measurements, downhole geochemical sampling and developments in a high temperature borehole televiewer have been assessed as methods of characterising flow paths, and thus identifying short circuits. The development and demonstration of downhole tracer techniques are reviewed. A multi-chambered sampling tool is being developed, and equations have been formulated for downhole injected tracer data to calculate the distribution of flow recovery and losses between the flow exits from an injection well. The use of reactive tracers at Rosemanowes has been seriously impeded by the presence of bacteria in the system. Bacteria have been shown to produce a reducing environment in the reservoir when carbohydrate gels are used as stimulation fluids. A single well tracer test has been carried out, and results indicate that the hydraulic behaviour of the well is not the same on injection as it is during venting. A possible means has been identified, whereby the thermal performance of a preferential flow path might be predicted using the same downhole tracer data used to identify its location. It has not been possible to demonstrate a sealant in the current Rosemanowes reservoir, apart from simple mechanical isolation of part of the wellbore, however, information has been gathered about the potential use of sealants. (author)

26046 (ETSU-G–151-P10) **Camborne geothermal energy project. Characterisation of the Rosemanowes HDR reservoir: (Report 3A-10).** Parker, R.H. (ed.). Camborne School of Mines (United Kingdom). Geothermal Energy Project. 1992. 180p. Sponsored by AEA Environment and Energy, Harwell (United Kingdom). Order Number DE93797876. Source: OSTI; NTIS (US Sales Only).

The main basis for the creation and circulation of experimental HDR reservoirs is to establish general relationships between fundamental HDR reservoir parameters (eg rock volume, well separation, permeability, chemical reaction rates) and the three main performance parameters; thermal performance, hydraulic impedance and water loss. This research is concerned with the establishment of such relationships. (author)

26047 (ETSU-G–151-P11) **Modelling and design of HDR reservoir creation: Camborne Geothermal Energy Project.** Parker, R.H. (ed.). Camborne School of Mines (United Kingdom). Geothermal Energy Project. 1992. 136p. Grant E/5A/CON/151/2034. Order Number DE93504500. Source: OSTI; NTIS (US Sales Only).

Four Fluid Rock Interaction models, used at the Camborne School of Mines Geothermal Energy Project, have been developed to assist in achieving the objective of validating the feasibility of creating a hot-dry-rock (HDR) reservoir suitable for commercial operation, including the concept of multi-stimulation. These models of differing degrees of complexity contribute specifically towards: (a) the development and verification of a numerical, three-dimensional model of the behaviour of jointed rock systems, for use in the stimulation design studies; (b) modelling the proposed stimulation procedures and determining the feasibility of reservoir creation and its sensitivity to the main stimulation parameters, including joint distribution, rock stress conditions, stimulation fluid properties, and pumping pressure and durations. Many possibilities for the enhancement of these models still remain. These would aim to improve their capabilities, both computationally and in the range of problems that can be modelled. Currently though, all these models are capable of simulating aspects of the stimulation process, from the hydraulic stimulation of a single fracture to the creation of a complete geothermal reservoir. They have been used to predict the structure and efficiency of a geothermal reservoir under different stimulation conditions. The reservoir structure is found to be extremely sensitive to many of the input parameters, such as the stress field and joint distribution. This accentuates the current difficulty in making accurate predictions of reservoir performance, whilst physical uncertainties are great. (author)

26048 (SAND–93-1271C) **Status of lost circulation research.** Glowka, D.A.; Schafer, D.M.; Wright, E.K.; Whitlow, G.L.; Bates, C.W. Sandia National Labs., Albuquerque, NM (United States). [1993]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-930484–6: Geothermal program review, Berkeley, CA (United States), 27-29 Apr 1993). Order Number DE93015659. Source: OSTI; NTIS; GPO Dep.

This paper describes progress made in the Lost Circulation Technology Development Program over the period March, 1992–April, 1993. The program is sponsored at Sandia National Laboratories by the US Department of Energy, Geothermal division. The goal of the program is to develop technology to reduce lost circulation costs associated with geothermal drilling by 30–50%.

1510 Direct Energy Utilization

26049 (ETDE-IT–93-154) **Utilization of low temperature geothermal water in traditional and advanced agricultural applications.** Rossi, L.; Pacciaroni, F. ENEA, Casaccia (Italy). 1992. 8p. (CONF-9210372–1: Workshop on the rational use of energy, Budapest (Hungary), 27-29 Oct 1992). Order Number DE93799182. Source: OSTI; NTIS (US Sales Only); INIS.

The locations of large amounts of low temperature geothermal sources (30 to 80 degrees C) have been identified in Italy and in many European countries; one of the most interesting utilization of these sources is greenhouse heating. Surplus investment in comparison with conventional heating systems is justified only by the application of low cost technologies for well completion, heating distribution and waste heat treatment. In the last few years, many efforts have been made in the development of these technologies and selection of more profitable crops. Since 1984, ENEA (Italian Agency for Energy, New Technologies and the Environment) has carried out experimental work in two geothermal stations located in Canino (VT) and in Gorgo di Latisana (UD). In these plants, a number of greenhouses enveloped with plastic film are provided with different heating systems; the combination of soil and forced air heating is preferred. Plastic pipes, buried in the soil, are used as soil heating for horticulture and fruit production. For plot plant cultivation, soil heating is obtained by plastic pipes half-buried in a concrete floor. Asparagus cultivation is carried out with buried pipes. No additional heating with conventional fuel is provided in any greenhouse. During these years, ENEA has developed heating and water distribution technologies: current industrial components are generally utilized. Moreover, ENEA has recently completed an advanced automatic control system able to control geothermal greenhouses, manage water distribution, save energy and optimize environmental conditions.

1520 Geothermal Data and Theory

26050 (DOE/ER/13419–T2) **[Diffusion/dispersion transport of chemically reacting species]: Progress report, FY 1992–1993.** Helgeson, H.C. California Univ., Berkeley, CA (United States). Dept. of Geology and Geophysics. [1993]. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG03-85ER13419. Order Number DE93017553. Source: OSTI; NTIS; GPO Dep.

Progress is reported on the following: calculation of activity coefficients for aqueous silica in alkali metal chloride solutions; calculation of degrees of formation of polyatomic clusters of Al in alkali chloride solutions; bulk composition-pH diagrams for arkosic sediments; and chemical interaction of petroleum, oil field brines, and authigenic mineral assemblages. Plans for future research are given.

26051 (DOE/ID/12945–T10) **A study of hydrocarbons associated with brines from DOE geopressured wells: Final report.** Keeley, D.F. University of Southwestern Louisiana, Lafayette, LA (United States). Acadiana Research Lab. [1993]. 70p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC07-90ID12945. Order Number DE93016285. Source: OSTI; NTIS; GPO Dep.

Accomplishments are summarized on the following tasks: distribution coefficients and solubilities, DOE design well sampling, analysis of well samples, review of theoretical models of geopressured reservoir hydrocarbons, monitor for aliphatic hydrocarbons, development of a ph meter probe, DOE design well scrubber analysis, removal and disposition of gas scrubber equipment at Pleasant Bayou Well, and disposition of archived brines.

16 TIDAL AND WAVE POWER

1604 Economic, Industrial, and Business Aspects

Refer also to citation(s) 26054

1607 Tidal Power Plants

26052 (ETSU-T–05-00155/REP) **Tidal stream energy review.** Engineering and Power Development Consultants Ltd., Sidcup (United Kingdom); Binnie and Partners, Redhill (United Kingdom); McAlpine (Sir Robert) and Sons Ltd., London (United Kingdom); IT Power, Eversley (United Kingdom). 1993. 100p. Order Number DE93504807. Source: OSTI; NTIS (US Sales Only).

Around the coasts of the British Isles there are sea areas with high velocity currents so that installations which could harness the energy might appear attractive. Two main problems exist: the difficulty of construction in the strong currents and the dispersion of energy, requiring large and expensive devices. A previous review of the subject had been carried out for the Energy Technology Support Unit in 1979 but it was considered appropriate to up-date the work in the light of presently available technology. Following submissions at the end of 1991, a review study was commissioned in March 1992 by ETSU. The aims of the study were essentially two-fold: to review the status of the technology for obtaining energy from tidal streams and to estimate the UK tidal stream energy resources and the likely costs of the energy which could be generated. (author)

26053 (ETSU-T–05-00155/REP-A) **Tidal stream energy review: Appendices.** Engineering and Power Development Consultants Ltd., Sidcup (United Kingdom); Coventry Univ. (United Kingdom); McAlpine (Sir Robert) and Sons Ltd., London (United Kingdom); IT Power Ltd., Eversley (United Kingdom). 1993. 214p. Order Number DE93506442. Source: OSTI; NTIS (US Sales Only).

This review gives an initial database search list; abstracts of references in secondary search; references of support structures; and documents received from ETSU relating to moorings and anchorages. A review of library material with regard to turbine plant is presented as well as electrically relevant literature and oceanographic references. Basic axial flow turbine sizing analysis is outlined, and sites for possible tidal stream energy generation are listed. (author)

1608 Wave Energy Converters

26054 (ETSU-WV–1685) **A parametric costing model for wave energy technology.** Atkins Oil and Gas Engineering Ltd., London (United Kingdom). 1992. 149p. Order Number DE93504797. Source: OSTI; NTIS (US Sales Only); INIS.

This document describes the philosophy and technical approach to a parametric cost model for offshore wave energy systems. Consideration is given both to existing known devices and other devices yet to be conceptualised. The report is complementary to a spreadsheet based cost estimating model. The latter permits users to derive capital cost estimates using either inherent default data or user provided data, if a particular scheme provides sufficient design definition for more accurate estimation. The model relies on design default data obtained from wave energy device designs and a set of specifically collected cost data. (author)

26055 (ETSU-WV–1690-P1) **Reliability and availability assessments of wave energy devices: Main report.** Advanced Mechanics and Engineering Ltd., Guildford (United Kingdom).

1992. [197p.] Order Number DE93504802. Source: OSTI; NTIS (US Sales Only).

The viability of a wave energy device is primarily dependent on the delivered cost of the electricity that it generates through its service life. The delivered cost of the electricity is in turn dependent on the capital cost of the device, the cost of maintaining and repairing the device and the quantity of electricity delivered throughout its lifetime. The through-life repair costs of a device and the quantity of electricity that it will deliver are in turn dependent on the reliability on the mechanical and electrical components that make up the device. The work reported on here has been undertaken with the objective of establishing some of the quantities needed for the calculation of the delivered cost of the electricity generated by each device. (author)

26056 (ETSU-WV–1690-P2) **Reliability and availability assessments of wave energy devices: Supporting appendices.** Advanced Mechanics and Engineering Ltd., Guildford (United Kingdom). 1992. 448p. Agreement E/5A/1690/2587. Order Number DE93504503. Source: OSTI; NTIS (US Sales Only).

Advanced Mechanics and Engineering Ltd. has been commissioned by the United Kingdom Energy Technology Support Unit (ETSU) to perform analyses leading to an assessment of the reliability and availability of four types of wave energy devices, viz: the Edinburgh Duck; the NEL Oscillating Water Column (Bottom Standing Terminator); the Bristol Cylinder; and the Circular SEA-Clam. This document contains the background documentation prepared during the course of the study and largely contained in the supporting appendices. (author)

26057 (ETSU-WV–1691) **Frame design options for a circular clam wave energy device.** Coventry Polytechnic Enterprises Ltd. (United Kingdom). 1992. 84p. Contract A/5A/1691/2642. Order Number DE93504806. Source: OSTI; NTIS (US Sales Only).

This report follows on from development work on the Circular Clam by Coventry Polytechnic between 1983 and 1986. It implements the recommendations of the Department of Energy report in 1986 that the reference frame should be further developed. Steel and concrete hull concepts were developed to a sufficient stage to allow budget costing. The original 1986 tubular steel frame concept was rejected by comparison of the weights and relative costs of the structure with the steel hull scheme. The steel hull section design was based on the side buoyancy space of a hopper dredger which it resembles. Plate thicknesses were found to be governed by fatigue. The hull could be built at a number of UK or continental shipyards. The steel hull will be ballasted with inert water allowing the device to be de-ballasted for maintenance. Budget cost estimates within the range of 1.17m pounds to 1.62m pounds per device were obtained. (author)

26058 (ETSU-WV–1693) **Consultancy on review of SEA Clam wave energy device.** Coventry Polytechnic Enterprises Ltd. (United Kingdom). 1992. 59p. Order Number DE93504502. Source: OSTI; NTIS (US Sales Only).

Three principal aspects of the development of the Circular SEA Clam wave energy device by the Energy Systems Group at Coventry Polytechnic are reviewed. Firstly, the mathematical modelling of the overall system performance and availability is reviewed and used to evaluate the likely effects on unit cost of electricity generation of variations in device design, power chain characteristics and operational water depth. The predicted cost is in the range 3.5 to 6.0 p/kWh. Secondly, the development of the flexible membranes is reviewed. The membranes probably constitute the largest risk element of the Clam device. Nevertheless, the results of testing to date, lead to the conclusion that membranes for less demanding wave energy applications can be designed to survive for an economically attractive lifetime. Finally, work world-wide on the Wells turbine is reviewed. Because of its simplicity and linear pressure drop/flow characteristic, it is eminently suited to wave energy applications. Its characteristics are now well understood by the Group. A series of programmes are available to predict, with some confidence, the starting and energy conversion performance of a turbine of particular geometry. Given appropriate attention to the aerodynamic design and to the geometry and surface finish of the rotor blades, at this stage a yearly mean efficiency of over 70% in appropriate wave climates can be expected. (author)

17 WIND ENERGY

1701 Resources and Availability (Climatology)

26059 (ENEA-RTI-INN–92-11) **Doppler velocimeter: Design proposal (part 2).** Barbini, R.; Colao, F.; Giorgi, M.; Stojanovic, V. ENEA, Frascati (Italy). 1992. 20p. (In Italian). (RTI-INN–92-11). Order Number DE93799188. Source: OSTI; NTIS (US Sales Only).

The Doppler velocimeter system proposed in this study is intended for wind velocity measurements with the use of LIDAR (light detection and ranging) technology. The system is based on a low pressure hybrid carbon dioxide laser whose beam is sent into the atmosphere and then reflected back by atmospheric particulates, which, blown by the wind, shift the incident radiation frequency according to the Doppler effect. The LIDAR echo is monitored by a telescope and sent onto a detector contemporaneously receiving continuous wave radiation from a local laser oscillator. The interaction of the two laser beams produces signals, including a signal at the beams' intermediate frequency. By analyzing this signal with conventional radiofrequency techniques, it's possible to derive the instantaneous wind velocity component, range resolved in the direction of the LIDAR beam.

26060 (ETSU-WN–6029-P1) **The impact of climate variability on the UK wind resource. Final report.** Palutikof, J.P. (East Anglia Univ., Norwich (United Kingdom). Climatic Research Unit); Guo, X.; Barthelmie, R.J.; Halliday, J.A.; Hitch, T.J. East Anglia Univ., Norwich (United Kingdom). Climatic Research Unit; Rutherford Appleton Lab., Chilton (United Kingdom). 1993. 150p. Contract E/5A/CON/6029/2208. Order Number DE93506441. Source: OSTI; NTIS (US Sales Only).

This report describes work carried out to assess the impact of climate variability on the U.K. wind resource. The project built on earlier work carried out for the Department of Energy, in which 38 hourly wind speed and direction records were assembled from around the British Isles. With one exception, Lerwick, all these records covered a period of less than 20 years. Records of less than 20 years are inadequate to investigate long-term variability in the wind field, and yet variability on these time scales does exist and has considerable implications for the wind energy industry. The objective of the project was therefore to evaluation the potential scale of long-term temporal variability in the wind resource of the U.K., and to assess the implications for the wind energy industry. Variations in both on-and off-shore resource were examined. A brief study of the possible implications of greenhouse-gas related warming for wind speeds over the British Isles was carried out. (author)

26061 (ETSU-WN–6029-P2) **The impact of climate variability on the UK wind resource. Final report: Appendices.** Palutikof, J.P. (East Anglia Univ., Norwich (United Kingdom). Climatic Research Unit); Guo, X.; Barthelmie, R.J.; Halliday, J.A.; Hitch, T.J. East Anglia Univ., Norwich (United Kingdom). Climatic Research Unit; Rutherford Appleton Lab., Chilton (United Kingdom). 1993. 148p. Contract E/5A/CON/6029/2208. Order Number DE93506440. Source: OSTI; NTIS (US Sales Only).

In Appendix 1, time series charts compare observed monthly mean wind speeds for the 38 stations with the wind speed predicted from the geostrophic wind. Appendix 2 presents time series charts of the reconstructed annual mean wind speeds for the 31 stations from 1881 to 1989. Tables of basic statistics calculated from the 1881-1989 reconstructed wind speed time series of the 31 stations are given in Appendix 3. Basic statistics for ten-year running means calculated from the reconstructed 1881-1989 wind speed time series of the 31 stations, and dates of the maximum and minimum wind speed for the 31 stations are tabulated in Appendices 5 and 6.

1704 Economic, Industrial, and Business Aspects

Refer also to citation(s) 26068

26062 (ETDE/JP-mf–93798910) **Prospect on new energies.: Wind power generation.** Institute of Applied Energy, Tokyo (Japan). Mar 1993. 28p. (In Japanese). Order Number DE93798910. Source: OSTI; NTIS; Available from The Institute of

Applied Energy, 14-2, Nishishinbashi 1-chome, Minato-ku, Tokyo, Japan.

This paper reports surveys on wind power generation carried out by the General Energy Engineering Research Institute of Japan. There has been worldwide heightening interest in wind power generation since the outbreak of the oil crises. Fifteen thousand wind power plants are in operation in California, and about 3,000 plants in Denmark are taking care of about 3% of the national power demand. An occurrence of global warming has drawn attention again to this energy, having caused active movements of expansion of its use in Europe. The 1980's has seen improvements in plants each with output from several ten kW to several hundred kW, having resulted in enhanced economic effects. Wind power generation is in the stage of commercialization in well suited topographies. Mitsubishi Heavy Industries of Japan has fabricated wind power generators of 300-kW class output on a trial basis, and sold subsequently 697 generators in the states of California and Hawaii where the machines are exhibiting creditable operation records. The company has received orders for 103 generators from the United Kingdom in 1992. The situation of wind power generation in Japan is such that eight plants are in test operations carried out by the Kyushu, Okinawa and Tohoku electric power companies. Interest is focused on their test results which should help contribute to preserving the earth. 6 refs., 9 figs., 6 tabs.

26063 (ETSU-WN–6027) **Wind farm balance of plant costs.** Craig, L.; Liebmann, C. Wind Energy Group Ltd., Southall (United Kingdom). 1992. 192p. Sponsored by AEA Environment and Energy, Harwell (United Kingdom). Contract E/5A/CON/6027/2216. (WEG–33-6217). Order Number DE93770013. Source: OSTI; NTIS (US Sales Only); INIS.

The study consisted of a detailed investigation of the infrastructure required for the construction and operation of a windfarm in the UK. Costing of the equipment and installation was carried out for three UK sites, with different physical characteristics. A literature survey was carried out to determine current practice in the siting of turbines within windfarms in Europe and the USA. Wind turbines were then laid out on the sites selected for study. Requirements and costs for roads, foundations and site buildings, site electrical system and grid connection, the supervisory control and data acquisition system were discussed and evaluated. A comparison between the balance of plant costs for the 33-metre MS-3 400 kW wind turbine and the 50-metre LS-2 1 MW wind turbine was made for each area of study. Overall balance of plant costs was reviewed, with an investigation of the cost components which are most sensitive to variations. The balance of plant costs averaged over the three sites were 13.0 p/kWh/annum for the MS3 windfarms and 10.6 p/kWh/annum for the LS-2 windfarms. Maps of the sites under investigation, design drawings and tables of costs are included to give supporting information to the text. (author).

26064 (NEI-SE–114) **Operating experiences from small and medium sized wind power plants 1989-1991: Final report.** Svensk Energi Utveckling AB, Stockholm (Sweden); Kraftfoeretagens Vindkraft AB, Stockholm (Sweden). Sep 1992. 48p. (In Swedish). Order Number DE93500836. Source: OSTI; NTIS; INIS; Also available from: Vattenfall AB, Research Vindenergi, attn. Anders Andersson, Box 88, S-620 20 Klintehamn, Sweden.

32 wind power plants, 50-300 kW, are included in this survey of availability, capacity factors, energy production and operational disturbances. Some results: Mean availability has been above 0.95, mean capacity factor 0.2. The investment cost is around 8000 SEK/kW (about 1400 USD/kW). The best installations can be profitable if electricity tax relief is granted. Most disturbances originate in the control systems, the generators and the yaw systems. (13 figs., 10 tabs.).

1705 Environmental Aspects

26065 (ETSU-WN–6056/026) **An investigation of the levels of electromagnetic radiation generated by wind turbines.** Morgan, C.A. Garrad, Hassan and Partners, Bristol (United Kingdom). 1992. 116p. Order Number DE93504801. Source: OSTI; NTIS (US Sales Only); INIS.

The issue of electromagnetic interference is arising with some regularity as various wind energy projects throughout the UK reach the stage where local authority planning approval is sought. To many of the parties involved, wind turbines represent an unknown quantity and hence objections to their siting must be expected. Wind turbines may cause electromagnetic interference through two quite distinct processes. The first occurs when the wind turbine scatters electromagnetic signals passing through the area of the site and essentially, provides a second path between the transmitter and receiver of the signal. The second source of interference arises when signals generated within the wind turbine itself affect communications equipment or, indeed, any electronic circuitry. A case in point is a wind farm project under development by Bonython Estates of Cornwall. The aim of this project was to investigate the emissions from the wind turbines proposed for the Bonython development. This was achieved by means of field measurements on existing installations. (author)

1706 Wind Energy Engineering

Refer also to citation(s) 26003

26066 (AUC-IBT-R–9313) **Fatigue tests on laminated wood beams: Partial report 12: Materials testing.** Pilegaard Hansen, L.; Rathkjen, A. Aalborg Universitetscenter (Denmark). Inst. for Bygningsteknik. Apr 1993. 125p. (In Danish). Contract TR-88.1040;Contract ENS-51171-91.0004. Order Number DE93500150. Source: OSTI; NTIS.

Fatigue properties of laminated wood beams were investigated during the period 1987-93 and described in previous reports. The results are presented here of uniaxial stretch and pressure mechanical testing carried out in parts cut out of the beams that had undergone fatigue testing. Photographs of the tested examples are included. (AB).

26067 (AUC-IBT-R–9315) **Fatigue tests on laminated wood beams: Partial report 14. Testing of series L.** Pilegaard Hansen, L.; Rathkjen, A. Aalborg Universitetscenter (Denmark). Inst. for Bygningsteknik. May 1993. 60 p.p. (In Danish). Contract TR-88.1040;Contract ENS-51171-91.004. Order Number DE93500098. Source: OSTI; NTIS.

In the case of these tests for fatigue in the case of laminated wooden beams, which could be used for wind turbine blades, it has been possible to affect the beam on each side of the central axis and to make relocation-controlled and strength- controlled tests. Relevant safeguards, a noise muffling screen and a fire alarm were developed. The results of the testing are presented and the text is illustrated with photographs of the testing in progress. (AB) (15 refs.).

26068 (ETDE-IT–93-178) **Experimental results of wind powered pumping plant with electrical transmission.** Falchetta, M.; Prischich, D.; Benedetti, A.; Cara, G. ENEA, Casaccia (Italy). 1992. 11p. (CONF-9206342–2: Potential for small and medium sized wind energy application in Mediterranean countries, Rodi (Greece), 25-27 Jun 1992). Order Number DE93799198. Source: OSTI; NTIS (US Sales Only); INIS.

A demonstrative application of deep well pumping system employing a wind powered pumping plant with an electric transmission was set-up and tested for two years at the test field of the Casaccia center of ENEA (Italian Agency for Energy, New Technologies and the Environment), near Rome. The tests permitted the evaluation of the practical performance, advantages and drawbacks of a wind pumping plant of this type, in order to permit a design optimization and a proper choice of components and of control strategies for future commercial applications. The main point of investigation was the evaluation of the effectiveness of a control scheme based on a 'permanent link' between electric generator and electric motor, avoiding any electronics and switching components, and leading to a very robust and reliable means of transferring energy to the pump at variable speed, and at low cost.

26069 (ETSU-N–124) **Safety, reliability and condition monitoring of wind turbines: Proceedings.** Smith, G.M. (Nottingham Univ. (United Kingdom)); Clayton, B.R. (eds.). AEA Environment

and Energy, Harwell (United Kingdom). 1992. 85p. (CONF-9209375–: Workshop on safety, reliability and condition monitoring of wind turbines, Nottingham (United Kingdom), 17 Sep 1992). Order Number DE93503574. Source: OSTI; NTIS (US Sales Only).

During recent years the number of wind turbines installed in the UK has grown rapidly. Operators of wind turbines require a reliable performance with minimum outage times in order to ensure commercial viability. Safety and reliability are clearly of paramount importance in achieving these aims and condition monitoring techniques need to be developed in order to ensure continuing structural integrity of the wind turbine and its components. It was with these thoughts in mind that this first BWEA/DTI workshop covering some aspects of the topic was organised. Dutch and Danish experiences were presented in order to widen the discussion. The contributions presented in these proceedings include: availability, reliability and maintainability (ARM) management for wind turbines; Danish rules for wind turbine safety and reliability; reliability and monitoring in wind engineering; development of standards and certification in the UK; condition monitoring for composite turbine blades; thermal inspection of composite structures; lubricant analysis as an indicator of wind turbine health. (author)

26070 (ETSU-N–124, pp. 1-2) **Safety and reliability on wind turbines - the Danish rules.** Winther-Jensen, M. (Risoe National Lab., Roskilde (Denmark). Test Station for Wind Turbines). AEA Environment and Energy, Harwell (United Kingdom). 1992. (CONF-9209375–: Workshop on safety, reliability and condition monitoring of wind turbines, Nottingham (United Kingdom), 17 Sep 1992). In *Safety, reliability and condition monitoring of wind turbines: Proceedings.* 85p. Order Number DE93503574. Source: OSTI; NTIS (US Sales Only).

Since the beginning of the eighties the Test Station for Wind Turbines has approved Danish wind turbines. Aspects such as safety and reliability are of course included in the approvals. Step by step a set of safety rules has been built up in the Danish certification system, becoming more exact with growing experience. The set of rules includes aspects such as safety according to third party (safety philosophy, braking systems, design, installation, quality assurance, O and M etc); labour safety (personal safety, admission possibilities, screening, blocking possibilities etc.); fire prevention; and electric safety. Likewise the reliability of a wind turbine has become a part of the approval procedure. The demand for reliability has risen and materials and components are increasingly chosen with this in mind. In the paper when presented, the progress made with respect to safety and reliability will be described and the present rules will be presented. (author)

26071 (ETSU-N–124, pp. 3-1-3-21) **Reliability and monitoring in wind engineering.** Rademakers, L.W.M.M. (Netherlands Energy Research Foundation (ECN), Petten (Netherlands)); Wekken, A.J.P. van der; Schuurman, J.J.; Seebregts, A.J. AEA Environment and Energy, Harwell (United Kingdom). 1992. (CONF-9209375–: Workshop on safety, reliability and condition monitoring of wind turbines, Nottingham (United Kingdom), 17 Sep 1992). In *Safety, reliability and condition monitoring of wind turbines: Proceedings.* 85p. Order Number DE93503574. Source: OSTI; NTIS (US Sales Only).

In this paper, two different projects will be presented. The first entitled 'Probabilistic Safety Assessment for Wind Turbines', described the applicability and feasibility of probabilistic techniques as a method for improving the reliability and safety of wind turbines. Besides a description of the working method, it is illustrated by a case study of the Lagerwey wind turbine LW 15/75. The second project is entitled 'Monitoring In Wind Engineering'. A description will be given of the measurements that are being carried out presently on two wind turbines in the Netherlands. The objective of the measurements is to collect operational data from these turbines. (author)

26072 (ETSU-N–124, pp. 4-1-4-10) **Development of standards and certification relating to the UK.** Elliot, G. (National Wind Turbine Centre (United Kingdom)). AEA Environment and Energy, Harwell (United Kingdom). 1992. (CONF-9209375–: Workshop on safety, reliability and condition monitoring of wind turbines, Nottingham (United Kingdom), 17 Sep 1992). In *Safety, reliability and condition monitoring of wind turbines: Proceedings.* 85p. Order Number DE93503574. Source: OSTI; NTIS (US Sales Only).

Standards that apply specifically to wind turbines do not yet exist in the UK but are in course of preparation. The British Standards Institute (BSI) carries out the government's obligations to ensure that appropriate standards are prepared. In the case of wind turbines however the initiative has been taken at international level by the International Electrotechnical Commission (IEC) and BSI carry out a purely reactive role. The standard "Safety of Wind Turbine Generator Systems", currently under development by the IEC, is outlined. Regulatory aspects are discussed in a UK context and the likely form and scope of UK certification is sketched. (author)

26073 (ETSU-N–124, pp. 5-1-5-10) **Condition monitoring techniques for composite wind turbine blades.** Dutton, A.G. (Rutherford Appleton Lab., Chilton (United Kingdom)); Irving, A.D.; Smith, G.M.; Clayton, B.R. AEA Environment and Energy, Harwell (United Kingdom). 1992. (CONF-9209375–: Workshop on safety, reliability and condition monitoring of wind turbines, Nottingham (United Kingdom), 17 Sep 1992). In *Safety, reliability and condition monitoring of wind turbines: Proceedings.* 85p. Order Number DE93503574. Source: OSTI; NTIS (US Sales Only).

Condition monitoring technologies have a broad range of application from quality assurance procedures during manufacture, through research into blade fatigue in the laboratory, to the inspection of working machines in the field. This paper is primarily concerned with discussing those techniques that might be developed for use on composite wind turbine blades in the field, but many of the methods described can and have been used to monitor manufacturing processes in other industries. By their very nature, the most promising of these techniques can be used to extract a lot of extra information about failure processes during laboratory fatigue tests. Most, if not all, the techniques have been developed for use on metal structures and attempts have been made elsewhere to apply them to composite materials. Methods specifically developed for use in composite structures are still in their infancy. At the present time there is no technique that can be immediately applied to composite wind turbine blades in the field. The principal contenders for development, though, are core acoustic emission, vibration monitoring and infrared thermography. Metal components and structures should be adequately covered by existing technologies and procedures. It is also worth noting that manufacturing processes involving composite materials are typically more subject to variation than those involving metals. (author)

26074 (ETSU-N–124) **Availability, reliability and maintainability (ARM) management for wind turbines.** Cummings, D.K. (Lloyd's Register of Shipping, Croydon (United Kingdom)). AEA Environment and Energy, Harwell (United Kingdom). 1992. (CONF-9209375–: Workshop on safety, reliability and condition monitoring of wind turbines, Nottingham (United Kingdom), 17 Sep 1992). In *Safety, reliability and condition monitoring of wind turbines: Proceedings.* 85p. Order Number DE93503574. Source: OSTI; NTIS (US Sales Only).

The risk associated with low plant availability is an important parameter for both operators and manufacturers of wind turbines to consider amongst other risks which must be successfully managed in their businesses. These pressures place potentially conflicting demands on the industry since the achievement of improved availability inevitably involves increased expenditure early in a project in order to obtain benefits later on. There is a need to balance total through life costs against benefits and to avoid expenditure which does not give compensatory improvements in performance. To help resolve this situation Availability, Reliability and Maintainability (ARM) Management techniques have been developed and used in industry to identify those areas of design and operation where increased effort is necessary to improve availability and to clarify the most effective means of improving it. (author)

26075 (ETSU-N–124) **Thermal inspection of composite structures.** Smith, G.M. (Nottingham Univ. (United Kingdom)); Clayton, B.R.; Dutton, A.G.; Irving, A.D. AEA Environment and Energy, Harwell (United Kingdom). 1992. (CONF-9209375–: Workshop on safety, reliability and condition monitoring of wind turbines, Nottingham (United Kingdom), 17 Sep 1992). In *Safety, reliability*

and condition monitoring of wind turbines: Proceedings. 85p. Order Number DE93503574. Source: OSTI; NTIS (US Sales Only).

Reviews of the established and developing inspection techniques for composites recognise the potential that thermal techniques have for the in-service examination of wind turbine blades. This derives from the non-contacting nature of most thermal methods combined with the physical properties of the glass fibre/polymer composites or wood/epoxy laminates from which the blades are constructed. In this paper thermal inspection techniques are described, and examples are given of their use on composites, mainly in applications other than wind engineering. The family of techniques involving thermal imaging divides into two main groups: one group is based on images produced after the external application of heat to the testpiece; and one group making use of the thermal images which result from the generation of heat within the material itself. From surface temperature variations measured as a function of time and position, stresses and structures at and beneath the surface can be derived. (author)

26076 (ETSU-N–124) **Lubricant analysis as an indicator of wind turbine machinery health.** Stuart, R.A. (Lloyd's Register of Shipping, Croydon (United Kingdom)). AEA Environment and Energy, Harwell (United Kingdom). 1992. (CONF-9209375–: Workshop on safety, reliability and condition monitoring of wind turbines, Nottingham (United Kingdom), 17 Sep 1992). In *Safety, reliability and condition monitoring of wind turbines: Proceedings.* 85p. Order Number DE93503574. Source: OSTI; NTIS (US Sales Only).

With their increased experience of wind energy machinery usage, many wind turbine manufacturers are now able to demonstrate machine availability factors in excess of 95%, for specified levels of operation and maintenance costs. The Lubricant Quality Scan (LQS) services outlined which are specifically designed to reduce unscheduled maintenance and the risk of catastrophic failure, help to ensure that these high machine availability factors are achievable and indeed they also serve to reduce the actual costs of operation and maintenance. LQS involves the analysis of samples of lubricants taken from key parts of the machinery at regular intervals so that wear particles can be detected. (author)

26077 (ETSU-WN–5051) **Modal survey of the 60m LS-1.** Warren, J.G. Wind Energy Group Ltd., Southall (United Kingdom). 1993. 127p. (WEG-MS–60-405). Order Number DE93505292. Source: OSTI; NTIS (US Sales Only).

During construction of the Orkney 60 metre WTG, it was recognized that the confirmation of structural dynamic properties by means of a modal survey would be a valuable aid to design verification. A proposal for such a survey was approved in July 1985. The general objective was to identify as built dynamic characteristics of the rotor and tower. Variations from design could have resulted in significant changes in the dynamic loading and response of the system, and this study was intended to identify any potential problems at the earliest opportunity. (Author)

26078 (ETSU-WN–5090) **Extended fatigue monitoring of the MS-1 WTG rotor.** Warren, J.G. Wind Energy Group Ltd., Southall (United Kingdom). 1992. 111p. Order Number DE93504796. Source: OSTI; NTIS (US Sales Only).

The fatigue monitoring study described in this report was instigated by the Department of Energy in order to supplement the fatigue data previously acquired during an earlier MS1 monitoring programme. The potential for a direct assessment of rotor fatigue life by a simple extrapolation was further reduced because of various MS1 configuration changes which were instigated during the fatigue monitoring programme. Nevertheless, a substantial data base was acquired which allowed rotor fatigue damage rates to be assessed and compared with those identified during the original study. This report includes sections on fatigue analysis procedures, the data available for analysis, and interpretation of the results. The remainder of this summary is arranged under the headings of the individual sections of the report. (author)

26079 (ETSU-WN–5099) **Integrated research programme for vertical axis wind turbine blade aerodynamics under environmental and wind tunnel conditions: Executive summary.** Vertical Axis Wind Turbines Ltd., Henel Hempstead (United Kingdom). 1993. 25p. Order Number DE93504808. Source: OSTI; NTIS (US Sales Only).

At high wind speeds VAWT's operate over a large amplitude of angle of attack with resulting massive separation at both extremes of the angle of attack range. This mechanism provides a passive form of power regulation and is a feature of the VAWT 260 (100kW) and more recent VAWT 850 (500kW) turbines. As a result the present aerodynamic research concentrates on the provision of an improved database of unsteady section characteristics using typical VAWT motions, pressure measurements on the blades of VAWT's and theoretical modelling of unsteady VAWT aerodynamics. This approach will improve the understanding of the two-dimensional unsteady aerodynamic behaviour of vertical axis wind turbines. (author)

26080 (ETSU-WN–5108) **Wind turbine control systems modelling and design. Phase I and II: Main report.** Leithead, W.E.; De La Salle, S.A.; Reardon, D.; Grimble, M.J. Strathclyde Univ., Glasgow (United Kingdom). 1992. 54p. Sponsored by AEA Environment and Energy, Harwell (United Kingdom). Contract E/5A/CON/5108/1851;E/5A/CON/6012/2121;E/5A/CON/5116/193 Order Number DE93797877. Source: OSTI; NTIS (US Sales Only).

The role of active feedback control of wind turbines, primarily by varying the pitch angle of the blades, is investigated. The models required for the control design are identified and the criterion for the assessment of the controller determined. Controllers for a fictitious wind turbine are designed using PI control, classical control and linear quadratic Guassian control. The performance of the controllers are evaluated and assessed by simulation studies. (author)

26081 (ETSU-WN–5127) **Testing of a torque-limiting gearbox on the Ilfracombe MS-2 WTG.** Haines, R.S.; Roughton, E.G.; Bossanyi, E.A. Wind Energy Group Ltd., Southall (United Kingdom). 1993. 130p. (WEG–25-4067-REV1). Order Number DE93504803. Source: OSTI; NTIS (US Sales Only).

A gearbox which permits the input shaft to slip indefinitely relative to the output whenever a set torque is reached is termed a "Torque Limiting Gearbox" (TLG). This report concerns the testing of a Wind Turbine Generator (WTG) of a TLG which also introduces compliance below the set torque. The concept is implemented by introducing a differential stage between the main gearbox and the generator, the torque at the secondary output of the differential being controlled by an hydraulic retarder. The differential pressure at the retarder is limited by a relief valve, with a combination of accumulator and restrictor providing passive compliance at lower pressures. Under conditions where the relief valve operates, retarder speed (and hence rotor speed) is limited by a simple PI controller operating on the rotor pitch. (author)

26082 (ETSU-WN–6023) **The effect of rotor characteristics on loading and fatigue life of a WTG in a wind farm.** Wastling, M.A.; Tindal, A.J. Garrad, Hassan and Partners, Bristol (United Kingdom). 1992. 148p. Order Number DE93504805. Source: OSTI; NTIS (US Sales Only).

A likely consequence of using wind turbines within wind farms is that rotors will experience an increase in dynamic loading associated with operation within wakes. A good understanding of this problem is essential if efficient and economic use is to be made of available wind farm sites. The objective of this analytical project was to combine the current understanding of wind conditions within wind farms, the loading of wind turbine rotors and the behaviour of materials used in their construction to predict how much stronger rotors need to be to survive in wind farms compared with the free stream. The study was based on realistic, but artificial wind turbine rotors. This made it possible to consider a wide range of different machine configurations to help identify the important parameters. (author)

26083 (ETSU-WN–6046) **Fatigue testing of 12M wind turbine blades.** Hancock, M.; Richmond, B. Wind Energy Group Ltd., Southall (United Kingdom). 1993. 41p. Contract E/5A/6046/2376. (WEG-R–37-6201). Order Number DE93505291. Source: OSTI; NTIS (US Sales Only).

The principal objective of this study was to establish the fatigue strength of typical wood/epoxy composite wind turbine blades and

determine representative fatigue lifetimes. Four blades were tested in the Civil Engineering Laboratory at City University. The blades were made in 1986 designed for use on an experimental stall-regulated rotor on the Wind Energy Group's MS2 machine at Ilfracombe. Three of these blades were actually run for a few hundred hours in the test programme. The fourth blade was made at the same time for testing prior to marketing in Europe but this was never done. (Author)

26084 (NEI-DK–1198) **Wind turbines modelling: An introduction to experimental identification.** Tantareaunu, C. Nordvestjysk Folkecenter for Vedvarende Energi, Hurup (Denmark). Jun 1992. 29p. Order Number DE93500176. Source: OSTI; NTIS.

Experimental identification in relation to wind turbines modelling is introduced. Such a model is complex because of the rapid variability of wind parameters and the constructive elasticity of the modern wind turbine. The model is required to simulated specific regimes, it helps in optimizing design and the control equipment. The modern adaptive control concept (on-line modelling), the basic mathematical techniques and how the wind conditions are included in the modelling, are dealt with. The author's software is presented and some results found in relevant literature related to both analytical and experimental models for medium and large wind turbines are given. (AB).

26085 (NEI-DK–1201) **First measurements on DANmark 36 - 525 kW wind turbine.** Vilsboell, N.; Kunwald, P.; Tantareanu, C. Nordvestjysk Folkecenter for Vedvarende Energi, Hurup (Denmark). Dec 1992. 38p. Order Number DE93500174. Source: OSTI; NTIS.

The report should be considered in relation to a previous one entitled 'The Research Measurement System on the DANmark 36 - 525 kW Wind Turbine'.

The report contains the first measurement results on the DANmark 36 - 525 kW wind turbine operating at Hanstholm, Denmark. The power spectral density functions were calculated from the records of the torque and bending movements, the data were sampled at 25 Hz. Tests were taken at stopped rotor, using several methods for mechanical excitation. The eigenfrequences of tower bending, rotor and transmission torsional, blade flapwise and blade chordwise are given in addition to the power and turbulence curves and data time tracks. The influence of the site topography on the performance of the windmill is also dealt with. (AB).

26086 (NEI-DK–1202) **The research measurement system on the DANmark 36 - 525 kW wind turbine.** Kunwald, P.; Tantareanu, C. Nordvestjysk Folkecenter for Vedvarende Energi, Hurup (Denmark). Nov 1992. 100p. Order Number DE93500160. Source: OSTI; NTIS.

The aim was to demonstrate the the industrial feasibility of a Danish manufactured standard wind turbine concept (three-bladed rotor up-wind, with stall regulation) of the DANmark 36 - 525 kW wind turbine. The turbine supplies electricity to the grid. Within 20 days the production was 103 kW. The results of the measurement project aimed to validate and improve the calculation code of the blades and structure. Particular attention was given to stresses on the yaw motors which can cause unreliability at long term operation. Dynamic wind loads and performance in relation to conditions of turbulence were also investigated. The characteristics of the site, the design of the turbine and the measurement system are described in addition to the methods of data acquisition and processing, the software tools and calibration of measurement channels. Samples of recorded signals from the transducers are given. (AB).

26087 (NEI-DK–1203) **Wind prediction in short term: A first step for a better wind turbine control.** Tantareanu, C. Nordvestjysk Folkecenter for Vedvarende Energi, Hurup (Denmark). Oct 1992. 37p. Order Number DE93500171. Source: OSTI; NTIS.

The report presents an experimental identification technique of a time series model using the Box-Jenkins methodology. An application study is made for a real wind speed data series. It is claimed that wind direction and especially speed as inputs in a wind turbine model have only a theoretical meaning. In fact the wind parameters vary in the rotor plane. The distance between the point where the wind is measured and the point of the turbine siting is significant. Another model is needed to make the transfer between the punctual measured wind parameters and the equivalent constant wind parameters in the rotor plane. Thus the wind model, the wind turbine model and the equivalence wind model together form the operation process model which should be used for optimizing wind turbine operation. The paper aims at presenting a case study for a wind speed prediction in short range term (seconds) using a real wind speed data series. At each forecast step the model is adapted to the real system parameters. The same mathematical techniques could be used for longer time periods, such as days. This wind speed prediction could be used for energy prediction in terms of hours for an optimum dispatching in power systems. The presented methodology has wide applications. The case study is described in detail. It is concluded that the model, if considered and calculated on-line using recursive algorithms, improves the performance of wind turbine control. Wind speed prediction is also improved. (AB).

26088 (NREL/TP–441-5611) **Circle diagram approach for self excited induction generators.** Muljadi, E.; Carlin, P.W.; Osgood, R.M. National Renewable Energy Lab., Golden, CO (United States). May 1993. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-83CH10093. Order Number DE93010031. Source: OSTI; NTIS; GPO Dep.

When an induction generator is connected to a utility line supply, the voltage and frequency at the terminal output are the same as the voltage and frequency of the utility line supply to which the generator is connected. The reactive power needed by the induction generator is supplied by the utility and the real power is returned to the utility. With a fixed frequency dictated by the utility, the induction machine starts generating above the synchronous speed. The range of speed is also limited by the slip. At a very high slip, the copper losses increases as the current increases. On the other hand, in an isolated operation, the induction generator operates in self-excitation mode. It determines its own voltage and frequency. These two quantities depend on the size of the AC capacitor, the induction machine parameters, the electrical load, and the speed of the generator. The operating speed of the induction generator is extended without generating excessive loss. This paper presents an analytical study by utilizing a circle diagram to illustrate the operation of the induction generator in isolated operation. The steady-state calculations are presented to support the analysis. Possible applications for the system in variable-speed generation are currently under investigation. The output can be directly connected to equipment that is non-sensitive to the frequency (a heater, battery charger, etc.) or can be connected to a converter to get a fixed-frequency AC output.

26089 (NREL/TP–442-4864) **Examination of forced unsteady separated flow fields on a rotating wind turbine blade.** Huyer, S. (Univ. of Colorado, Boulder, CO (US)). National Renewable Energy Lab., Golden, CO (United States). Apr 1993. 247p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-83CH10093. Order Number DE93010011. Source: OSTI; NTIS; GPO Dep.

The wind turbine industry faces many problems regarding the construction of efficient and predictable wind turbine machines. Steady state, two-dimensional wind tunnel data are generally used to predict aerodynamic loads on wind turbine blades. Preliminary experimental evidence indicates that some of the underlying fluid dynamic phenomena could be attributed to dynamic stall, or more specifically to generation of forced unsteady separated flow fields. A collaborative research effort between the University of Colorado and the National Renewable Energy Laboratory was conducted to systematically categorize the local and global effects of three- dimensional forced unsteady flow fields.

26090 (VF-UD–92-49) **Development study of a large wind turbine system, Third generation: Final report phase 1 - general conditions.** Svensson, Paer. Vattenfall AB, Vaellingby (Sweden). Dec 1992. 59 p.p. (In Swedish). Order Number DE93500928. Source: OSTI; NTIS.

The aim for the complete Development study III is to reach a design for the third generation of large wind turbines which can prove to produce electricity at a competitive cost. This report presents the results from phase 1, in which the conditions for the whole study are established. The main items during phase 1 are to define loads and technical requirements together with the economical conditions

for large wind turbines. A wind and load description which is based on the present work on standards for wind energy converters within IEC has been developed. Together with the technical specification it forms the fundamentals for the future work. The new wind description results in substantially decreased loads for the Naesudden II design (35% at some components) and further load reductions may be reached through modifications of the design. The allowed cost for future commercial development of power production plants in Sweden will be low during the next ten years. In the year 2000 an allowed cost of 0.26 SEK/kWh in today's price level is expected. However, a decision about carbon dioxide taxes will increase the interest in wind energy in Europe and maybe in Sweden. The target cost for the unit in Development Study III is 3.00 SEK/kWh/year, which is based on actual costs of small wind turbines. This means a cost which is only one third of the cost for a new Naesudden II unit. (12 refs., 5 figs, 4 tabs.).

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26091 (ANL–92/2-Vol.2) **COMMIX-PPC: A three-dimensional transient multicomponent computer program for analyzing performance of power plant condensers: Volume 2, User's guide and manual.** Chien, T.H.; Domanus, H.M.; Sha, W.T. Argonne National Lab., IL (United States). Feb 1993. 217p. Sponsored by Taiwan Power Co., Taipei (Taiwan, Province of China). DOE Contract W-31109-ENG-38. Order Number DE93012309. Source: OSTI; NTIS; GPO Dep.

The COMMIX-PPC computer program is an extended and improved version of earlier COMMIX codes and is specifically designed for evaluating the thermal performance of power plant condensers. The COMMIX codes are general-purpose computer programs for the analysis of fluid flow and heat transfer in complex industrial systems. In COMMIX-PPC, two major features have been added to previously published COMMIX codes. One feature is the incorporation of one-dimensional conservation of mass. momentum, and energy equations on the tube side, and the proper accounting for the thermal interaction between shell and tube side through the porous medium approach. The other added feature is the extension of the three-dimensional conservation equations for shell-side flow to treat the flow of a multicomponent medium. COMMIX-PPC is designed to perform steady-state and transient three-dimensional analysis of fluid flow with heat transfer in a power plant condenser. However, the code is designed in a generalized fashion so that, with some modification. it can be used to analyze processes in any heat exchanger or other single-phase engineering applications.

26092 (CONF-930401–18) **An optical technique for characterizing the liquid phase of steam at the exhaust of an LP turbine.** Kercel, S.W. (Oak Ridge National Lab., TN (US)); Simpson, M.L.; Azar, M.; Young, M. Oak Ridge National Lab., TN (United States). [1993]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Meeting on nuclear plant instrumentation, control and man-machine interface technologies; Oak Ridge, TN (United States); 18-21 Apr 1993. Order Number DE93015326. Source: OSTI; NTIS; INIS; GPO Dep.

Optical observation of velocity and size of water droplets in powerplant steam has several applications. These include the determination of steam wetness fraction, mass flow rate, and predicting erosion of turbine blades and pipe elbows. The major advantages of optical techniques are that they do not interfere with the flow or perturb the observation. This paper describes the measurement of the size and velocity of particles based on the observation and analysis of visibility patterns created by backscattered circularly polarized light. The size of latex particles in a dry nitrogen stream was measured in the laboratory. Visibility patterns of water droplets were observed in the low pressure turbine of Unit 6 of Alabama Power's Gorgas Steam Plant.

26093 (DOE/METC–92/6128-Vol.1, pp. 9-16) **Combustion Engineering IGCC repowering project.** Thibeault, P.R. (Combustion Engineering, Inc., Windsor, CT (US)); Gibson, C.R. USDOE Morgantown Energy Technology Center, WV (United States). Sep 1992. (CONF-920951–Vol.1: 12. annual gasification and gas stream cleanup systems contractors review meeting, Morgantown, WV (United States), 15-17 Sep 1992). In *Proceedings of the twelfth annual gasification and gas stream cleanup systems contractors review meeting: Volume 1.* 325p. Order Number DE93000228. Source: OSTI; NTIS.

The objective of this project is to demonstrate the Combustion Engineering, Inc. (C-E) advanced integrated coal gasification combined cycle system (IGCC) which is capable of providing high performance, cost competitive, environmentally compliant electric power. The integrated performance to be demonstrated will include all major subsystems in the IGCC system including coal feeding, C-E's advanced air-blown coal gasification, advanced methods of coal cleanup, a conventional combustion turbine adapted to use low-Btu coal gas as fuel, and the integration of the combustion turbine with a steam turbine to provide a combined cycle.

26094 (DOE/METC–92/6128-Vol.1, pp. 17-24) **Tampa Electric Company integrated gasification combined cycle project.** USDOE Morgantown Energy Technology Center, WV (United States). Sep 1992. (CONF-920951–Vol.1: 12. annual gasification and gas stream cleanup systems contractors review meeting, Morgantown, WV (United States), 15-17 Sep 1992). In *Proceedings of the twelfth annual gasification and gas stream cleanup systems contractors review meeting: Volume 1.* 325p. Order Number DE93000228. Source: OSTI; NTIS.

The primary objective of this Cooperative Agreement is to conduct a cost shared project that will demonstrate oxygen-blown entrained-flow Integrated Gasification Combined Cycle (IGCC) technology. The parties anticipate that, if the demonstration project is successful, the oxygen-blown entrained-flow IGCC technology could become commercialized during the 1990's and will be capable of (1) achieving significant reductions in the emissions of sulfur dioxide and the oxides of nitrogen from existing facilities to minimize environmental impacts such as transboundary and interstate pollution, and (2) providing for future energy needs in an environmentally acceptable manner.

26095 (DOE/METC–92/6128-Vol.1, pp. 25-33) **Pinon Pine IGCC project status update, August 1992.** Motter, J.W. (Sierra Pacific Power Company, Reno, NV (US)); Pitcher, J.D.; Fankhanel, M.; Campbell, W. USDOE Morgantown Energy Technology Center, WV (United States). Sep 1992. (CONF-920951–Vol.1: 12. annual gasification and gas stream cleanup systems contractors review meeting, Morgantown, WV (United States), 15-17 Sep 1992). In *Proceedings of the twelfth annual gasification and gas stream cleanup systems contractors review meeting: Volume 1.* 325p. Order Number DE93000228. Source: OSTI; NTIS.

Since the recent (August, 1992) execution of the Cooperative Agreement, the major focus of work has been on critical-path environmental permitting activities, both related to the NEPA process as well as state and local activities. Pending approval of the project by the Nevada Public Service Commission, detailed engineering activities will commence in November. Federal funding of the project automatically invokes environmental review under the National Environmental Policy Act (NEPA). This project will require an Environmental Impact Statement, or EIS, with DOE as the lead agency for the NEPA reviews. The project must also be approved by the Nevada Public Service Commission (PSCN) in the state's Resource Planning process. To date, milestones that have been met include publication of the Notice of Intent in June, Public Scoping Meetings in July of 1992, and the submission of SPPCo.'s Resource Plan to the PSCN, with the project included as part of the Recommended Resource Plan. SPPCo. has also completed an Environmental Information Volume for the project.

26096 (DOE/METC–92/6128-Vol.1, pp. 34-41) **Wabash River Coal Gasification Repowering Project.** Amick, P. (Destec Energy, Inc., Houston, TX (US)); Fisackerly, R.; Spears, R.C.; Cook, J.J. USDOE Morgantown Energy Technology Center, WV (United States). Sep 1992. (CONF-920951–Vol.1: 12. annual gasification

and gas stream cleanup systems contractors review meeting, Morgantown, WV (United States), 15-17 Sep 1992). In *Proceedings of the twelfth annual gasification and gas stream cleanup systems contractors review meeting: Volume 1.* 325p. Order Number DE93000228. Source: OSTI; NTIS.

The Project's sponsors, PSI Energy, Inc. and Destec Energy, Inc., will demonstrate, in a fully commercial setting, coal gasification repowering of an existing generating unit affected by the Clean Air Act Amendments ("CAAA"). The Project will also demonstrate important advancements in Destec's coal gasification process for high sulfur bituminous coal. Upon completion, the Project will not only represent the largest CGCC power plant in operation in the United States but will also emit lower emissions than any other high sulfur coal fired power plant.

26097 (DOE/METC–92/6128-Vol.1, pp. 53-63) **Hot gas cleanup test facility for gasification and pressurized combustion.** USDOE Morgantown Energy Technology Center, WV (United States). Sep 1992. (CONF-920951–Vol.1: 12. annual gasification and gas stream cleanup systems contractors review meeting, Morgantown, WV (United States), 15-17 Sep 1992). In *Proceedings of the twelfth annual gasification and gas stream cleanup systems contractors review meeting: Volume 1.* 325p. Order Number DE93000228. Source: OSTI; NTIS.

Southern Company Services, Inc. (SCS) has entered into an agreement with the Department of Energy, Morgantown Energy Technology Center (DOE/METC) to design, construct and operate the Hot Gas Cleanup Test Facility for Gasification and Pressurized Combustion. The purpose is to identify and evaluate potential hot particulate cleanup systems on a scale large enough so that these system can be related to potential commercial system. This entails first developing the criteria for engineering scale testing of hot particulate control devices which will lead to the design, construction and operation of a flexible test facility capable of operating under gasification and PFBC conditions.

26098 (DOE/METC–92/6128-Vol.1, pp. 77-83) **Gasifiers optimized for fuel cell systems.** Fruchtman, J. (Energy Research Corp., Danbury, CT (US)); Steinfeld, G.; Hauserman, W.B.; Lee, A.; Meyers, S.J. USDOE Morgantown Energy Technology Center, WV (United States). Sep 1992. DOE Contract AC21-90MC27227. (CONF-920951–Vol.1: 12. annual gasification and gas stream cleanup systems contractors review meeting, Morgantown, WV (United States), 15-17 Sep 1992). In *Proceedings of the twelfth annual gasification and gas stream cleanup systems contractors review meeting: Volume 1.* 325p. Order Number DE93000228. Source: OSTI; NTIS.

The overall objective of this effort is to identify coal gasification systems that significantly improve the performance, economics and efficiency of electric power generation systems in which coal gasification is integrated with carbonate fuel cells. This objective is to be accomplished by design studies of conceptual integrated coal gasification/fuel cell systems comprised of coal gasification, gas cleanup, fuel cells, and ancillary components required for a complete coal based power plant system. The integrated systems will not produce tars, char, fuel gases or steam as by-products.

26099 (DOE/METC–92/6128-Vol.1, pp. 84-94) **Integrated operation of a pressurized fixed bed gasifier and hot gas desulfurization system.** Gal, E. (GE Environmental Services, Inc., Lebanon, PA (US)); Furman, A.H.; Ayala, R. USDOE Morgantown Energy Technology Center, WV (United States). Sep 1992. (CONF-920951–Vol.1: 12. annual gasification and gas stream cleanup systems contractors review meeting, Morgantown, WV (United States), 15-17 Sep 1992). In *Proceedings of the twelfth annual gasification and gas stream cleanup systems contractors review meeting: Volume 1.* 325p. Order Number DE93000228. Source: OSTI; NTIS.

The primary objective of this contract continues to be the demonstration of high temperature fuel gas desulfurization and particulate removal using a moving bed process with a regenerable metal oxide sorbent. The fuel gas source for test operation is a fixed bed, air blown gasifier located at GE Corporate Research and Development in Schenectady, New York. The demonstration project also includes the design, construction, installation and test operation of a gasoline simulator which includes a modified GE MS6000 type gas turbine combustor and a film cooled, first stage LM 6000 nozzle assembly. The hot gas cleanup (HGCU) system and the gas turbine simulator have been designed to operate with the full 8000 lb/hr fuel gas flow from the gasification of 1800 lb/hr of coal at 280 psig and 1000 to 1150 F. An advanced formulation of zinc ferrite as well as zinc titanate have been used as the regenerable metal oxide sorbents in testing to date. Demonstration of halogen removal as well as characterization of alkali and heavy metal concentrations in the fuel gas remain objectives, as well.

26100 (DOE/METC–92/6128-Vol.1, pp. 119-126) **Mild gasification in transport reactors.** Bates, S.C. (Advanced Fuel Research, Inc., East Hartford, CT (US)); Zhao, Yuxin. USDOE Morgantown Energy Technology Center, WV (United States). Sep 1992. DOE Contract FG05-90ER80877. (CONF-920951–Vol.1: 12. annual gasification and gas stream cleanup systems contractors review meeting, Morgantown, WV (United States), 15-17 Sep 1992). In *Proceedings of the twelfth annual gasification and gas stream cleanup systems contractors review meeting: Volume 1.* 325p. Order Number DE93000228. Source: OSTI; NTIS.

The objective of this Phase II SBIR research program is to develop an integrated process for coal conversion in a combined gas turbine/stream turbine to produce: Liquids for use as a peaking fuel or as a feedstock for upgrading to transportation fuel and/or chemicals. Electricity generated at high efficiency (> 42%) and low cost ($1000/kw).

26101 (DOE/METC–92/6128-Vol.1, pp. 127-133) **Evaluation of options for CO_2 capture/utilization/disposal.** Livengood, C.D. (Argonne National Laboratory, IL (US)); Doctor, R.D. USDOE Morgantown Energy Technology Center, WV (United States). Sep 1992. (CONF-920951–Vol.1: 12. annual gasification and gas stream cleanup systems contractors review meeting, Morgantown, WV (United States), 15-17 Sep 1992). In *Proceedings of the twelfth annual gasification and gas stream cleanup systems contractors review meeting: Volume 1.* 325p. Order Number DE93000228. Source: OSTI; NTIS.

The primary objective of this project is to develop in-depth engineering evaluations of technologies for the capture, use, and disposal of carbon dioxide (CO_2). This project emphasizes CO_2-capture technologies combined with integrated gasification combined-cycle (IGCC) power systems. Complementary evaluations will address CO_2 transportation, CO_2 use, and options for the long-term sequestration of unused CO_2. Commercially available CO_2-capture technology will provide performance and economic baselines for comparing innovative technologies. These results will then support recommendations for research and development to improve CO_2 capture and use, new process concepts, and optimized energy balances for CO_2 mitigation. Limited experimental research will provide data for evaluating new concepts.

26102 (DOE/METC–92/6128-Vol.1, pp. 154-164) **Thermal conductivity of coal ashes and slags.** Nowok, J.W. (Univ. of North Dakota, Grand Forks (US)); Steadman, E.N. USDOE Morgantown Energy Technology Center, WV (United States). Sep 1992. (CONF-920951–Vol.1: 12. annual gasification and gas stream cleanup systems contractors review meeting, Morgantown, WV (United States), 15-17 Sep 1992). In *Proceedings of the twelfth annual gasification and gas stream cleanup systems contractors review meeting: Volume 1.* 325p. Order Number DE93000228. Source: OSTI; NTIS.

The purpose of this work is twofold: (1) to gain an understanding of the effects of mineralogical inhomogeneity and porosity of coal ash deposits on the heat-transfer phenomena, and (2) to determine the relationship between thermal and electrical conductivities in the temperature range of 25°-500°C. This new program was initiated at the Energy and Environmental Research Center (EERC) in 1991 to elucidate the cause of significant heat-transfer problems in the convective pass of utility boilers.

26103 (LUTMDN-TMVK–7010) **Evaporative gas turbine cycles: A thermodynamic evaluation of their potential.** Rosen, P.M. Lund Univ. (Sweden). Dept. of Heat and Power Engineering. Mar 1993. 59p. Order Number DE93500698. Source: OSTI; NTIS.

The report presents a systematic method of thermodynamically evaluating different gas turbine cycles, treating the working fluids as

ideal gases ($c_p=c_p(T)$). All models used to simulate different components in the cycles are presented in the report in detail and then connected in a computer program fully developed by the author. The report focuses on the theme of evaporative gas turbine cycles, in which low level heat is used to evaporate water into the compressed air stream between the compressor and recuperator. This leads to efficiency levels close to a comparable combined cycle but without the steam bottoming cycle. A parametric analysis has been conducted with the aim of deciding the best configuration of an evaporative cycle both for an uncooled expander and for a cooled expander. The model proposed to simulate the cooled expander is a combination between two existing models. (121 refs., 35 figs.,).

26104 (NEI-DK–1195) **District heating master plan study and assessment. Szazhalombatta: Final report.** Danish Energy Consultants, Glostrup (Denmark). May 1993. 119p. Contract ENS-2124/93-0001. Order Number DE93500111. Source: OSTI; NTIS.

The report deals with the district heating system in Szazhalombatta in Hungary, the steam transmission pipes to an oil refinery and the latter's energy consumption. The two heat consumers (the district heating system and the refinery) buy heat in the form of hot water and steam from the power plant. The largest consumer is the oil refinery with approximately 90% of the total annual heat production from the power plant. 5% of the power production is used by the power plant itself, which is explained by the cold winters and the fact that it is an open air plant. The total heat capacity demand is expected to be 512 MJ/s in 2012. If energy savings (primarily a steam condensate return system) are introduced, heat capacity demand will fall by 43 MJ/s and energy demand will decrease by 680 Tj in 2012. In this feasibility analysis the situation with regard to these plants is described in detail with reference to market, financial and technical aspects and principles of design for heat production systems. Comprehensive recommendations are given by the Danish consultant company for initiating energy savings in a society facing vast economical and organizational changes as a result of transformation to a market economy. (AB).

2002 Waste Management

Refer also to citation(s) 25505, 25508, 25512, 25513, 25514, 25517, 25550, 25551, 25552, 25553, 25554, 25555, 25575, 25576, 26094, 26095, 26096, 26099, 27321, 27330

26105 (DOE/METC–92/6128-Vol.1, pp. 64-76) **Second-generation PFBC systems research and development-phase 2.** Carli, G. (Foster Wheeler Development Corp., Livingston, NJ (US)); Crooker, P.; Froehlich, R.; Kahrs, S.; Kulcsar, D.; Lu, Chongqing; Mack, A.; Malenboym, P.; Torpey, M. USDOE Morgantown Energy Technology Center, WV (United States). Sep 1992. (CONF-920951–Vol.1: 12. annual gasification and gas stream cleanup systems contractors review meeting, Morgantown, WV (United States), 15-17 Sep 1992). In *Proceedings of the twelfth annual gasification and gas stream cleanup systems contractors review meeting: Volume 1.* 325p. Order Number DE93000228. Source: OSTI; NTIS.

Three major objectives of Phase 2 are: Separately test key components [the carbonizer, circulating pressurized fluidized bed combustor (CPFBC), cross-flow filter, and topping combustor] of second-generation PFB combustion plants at laboratory scale to ascertain their performance characteristics; Revise the commercial plant performance and economic predictions where necessary; Prepare for a 1.6-MWe equivalent Phase 3 integrated sub- system test of the key components.

26106 (DOE/METC–92/6128-Vol.1, pp. 95-104) **Integration and testing of hot desulfurization and entrained flow Gasification for power generation systems.** Jung, D.Y. (Montebello Research Laboratory, CA (US)); Kassman, J.S.; Leininger, T.F.; Wolfenbarger, J.K.; Yang, P.P. USDOE Morgantown Energy Technology Center, WV (United States). Sep 1992. (CONF-920951–Vol.1: 12. annual gasification and gas stream cleanup systems contractors review meeting, Morgantown, WV (United States), 15-17 Sep 1992). In *Proceedings of the twelfth annual gasification and gas stream cleanup systems contractors review meeting: Volume 1.* 325p. Order Number DE93000228. Source: OSTI; NTIS.

The objective of this project is to develop hot gas cleanup processes for incorporation into the Texaco Coal Gasification Process (TCGP). Both in-situ and external hot gas desulfurization have been investigated from a technical and economical perspective.

26107 (DOE/METC–92/6128-Vol.1, pp. 105-108) **Calderon coal gasification process development unit design and test program.** Madison, E. (Calderon Energy Company, Bowling Green, OH (US)); Probert, P.; Calderon, A. USDOE Morgantown Energy Technology Center, WV (United States). Sep 1992. (CONF-920951–Vol.1: 12. annual gasification and gas stream cleanup systems contractors review meeting, Morgantown, WV (United States), 15-17 Sep 1992). In *Proceedings of the twelfth annual gasification and gas stream cleanup systems contractors review meeting: Volume 1.* 325p. Order Number DE93000228. Source: OSTI; NTIS.

The Calderon process integrates the production of a rich fuel gas for methanol conversion and a lean fuel gas for electric power generation. The feeds to this process include run-of-mine coal, air, water and make up lime sorbent, while the major products are methanol and electricity. Slag and elemental sulfur are by-products. The test program is intended to demonstrate the integrated operation of the separate components of the Calderon gasification/hot gas cleanup process, and to duplicate conditions that would occur in a commercial application of the process. In this way its operation is to provide necessary design data and demonstration of process and equipment including materials of construction.

26108 (ETDE/JP-mf–93798681, pp. 42-45) **Simultaneous desulfurization-denitrification technology using electron beams.** Aoki, S. (Ebara Corp., Tokyo (Japan)). 20 Jan 1993. 94p. (In Japanese). In *Symposium on global environmental conservation and air pollution prevention technology.* Order Number DE93798681. Source: OSTI; NTIS (US Sales Only).

This paper summarizes an electron beam method capable of removing sulfur and nitrogen in a dry method as a new technology, its desulfurizing and denitrifying performances, and the pilot test under way (gas treatment amount of 12000 Nm^3/h). The method irradiates electron beams onto stack gas under coexistence of ammonia gas. The irradiation generates chemically active species with which sulfur and nitrogen oxides react to turn into sulfuric acid and nitric acid, and further convert into aerosols of ammonium sulfate and ammonium nitrate. The aerosols are removed by electric dust collectors or bag filters. The method features that it produces no waste water, can remove SOx and NOx simultaneously at high efficiency, requires simple facility with easy operation and no expensive catalysts, and can utilize the by-products as fertilizers. It was learned from basic experiments that the lower the temperature, the higher desulfurization rate can be achieved, and a multi-stage irradiation improves the denitrification efficiency. The pilot test is being carried out with a schedule having started in November 1992 to last for one year. 3 figs.

26109 (OCDO–93013792) **Catalytic reduction of SO_x-NO_x in coal flue gas: Phase 1 report.** Ohio Coal Development Office, Columbus, OH (United States). 20 Apr 1988. 160p. Sponsored by Ohio State Government, Columbus, OH (United States). Grant CDO/D-86-18. Source: OSTI; Ohio Coal Development Office, 77S. High Street, P.O. Box 1001, Columbus, OH 43266-0001.

Engineering drawings for this project are identified as CAPE–3056. Inquiries may be directed to: Office of Scientific and Technical Information P.O. Box 62, Oak Ridge, TN 37831.

The overall project objective is to provide industry with technology and equipment to assure cost-effective reduction of So_2 and NO_x emissions to encourage increased use of Ohio coal. A prime preference is to remove both SO_2 and NO_x in a single process step, while generating a revenue-producing and readily marketable byproduct. This project addresses both the definition of preferred technology and pilot scale facilities to demonstrate the process performance while removing SO_2 and NO_x from flue gas produced by burning Ohio coal. The specific project objective is to advance development of the Parsons process by determining if a catalytic hydrogenator can effectively function with flue gas from a coal

boiler. Specific project goals include: (1) 90% SO_2 control, minimum, (2) 90% NO_x control, minimum. (3) Competitive and viable levelized costs. The Parsons process consists of three key process units, each of which has been proven in commercial application. (1) A Beavon Sulfur Recovery (BSR) hydrogenation unit to simultaneously reduce the SO_2 to hydrogen sulfide (H_2S) and the NO_x to elemental nitrogen (N_2). (2) A FLEXSORB SE® PLUS process to recover H_2S from the BSR effluent; its product is the feed stream to the sulfur production ratio. (3) A Recycle Selectox Process unit to convert the H_2S to elemental sulfur. Each of the above process steps has been awarded patents.

26110 (OCDO–93013793) **Catalytic reduction of SO_x-NO_x in coal flue gas: Supplement to the final report.** Ohio Coal Development Office, Columbus, OH (United States); Columbia Gas System Service Corp., Columbus, OH (United States). Research Dept.; Parsons (Ralph M.) Co., Pasadena, CA (United States); Delaware Univ., Newark, DE (United States). Center for Catalytic Science and Technology. Nov 1991. 180p. Sponsored by Ohio State Government, Columbus, OH (United States). Source: OSTI; Ohio Coal Development Office, 77 S. High Street, P.O. Box 1001, Columbus, OH 43266-001 (United States).

Almost half of the coal purchased by the utilities that year was not Ohio coal. The 20-plus million tons/year of non-Ohio coal consumed by Ohio generators is an indication of the order of magnitude of the potential market incentive for Ohio to supply its power plants from its indigenous coal mine. The major reason for the drop in Ohio coal production rate is that the average content of Ohio coal is 3.5 weight percent, with a range of one to six percent. Use of high-sulfur coal introduces environmental problems due to the high SO_2 emission rate in the boiler flue gas. Potential solutions include use of alternative low-sulfur non-Ohio coal and addition of SO_2 (and NO_x) removal facilities. The substitution of non-Ohio low-sulfur coal for Ohio coal is a strong negative for the state and its coal mining industry; it means further shrinkage of the state's coal industry accompanied by loss of Ohio jobs. The Parsons FGC process is a candidate for the alternative solution, i.e., to provide high efficiency post-combustion removal of SO_2 (and NO_x). The Phase 2 pilot plant test results have demonstrated that the Parsons FGC process is capable to remove 99-plus percent of SO_2 and 95-plus percent of NO_x from coal-fired boiler flue gas. The Parsons FGC process will permit Ohio coal fired power plants to burn high-sulfur Ohio coal and achieve conformance with provisions of the Clean Air Act Amendments of 1990. Because SO_2 reduction using the Parsons FGC process will be greater than the amendment requirement, its use will provide the affected Ohio power plant with marketable net allowances having a definite economic value.

2005 Environmental Aspects

Refer also to citation(s) 27272

26111 (ANL/EAIS–5) **Impact on the steam electric power industry of deleting Section 316(a) of the Clean Water Act: Energy and environmental impacts.** Veil, J.A.; VanKuiken, J.C.; Folga, S.; Gillette, J.L. Argonne National Lab., IL (United States). Environmental Assessment and Information Sciences Div. Jan 1993. 39p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. Order Number DE93011232. Source: OSTI; NTIS; INIS; GPO Dep.

Many power plants discharge large volumes of cooling water. In some cases, the temperature of the discharge exceeds state thermal requirements. Section 316(a) of the Clean Water Act (CWA) allows a thermal discharger to demonstrate that less stringent thermal effluent limitations would still protect aquatic life. About 32% of the total steam electric generating capacity in the United States operates under Section 316(a) variances. In 1991, the US Senate proposed legislation that would delete Section 316(a) from the CWA. This study, presented in two companion reports, examines how this legislation would affect the steam electric power industry. This report quantitatively and qualitatively evaluates the energy and environmental impacts of deleting the variance. No evidence exists that Section 316(a) variances have caused any widespread environmental problems. Conversion from once-through cooling to cooling towers would result in a loss of plant output of 14.7-23.7 billion kilowatt-hours. The cost to make up the lost energy is estimated at $12.8-$23.7 billion (in 1992 dollars). Conversion to cooling towers would increase emission of pollutants to the atmosphere and water loss through evaporation. The second report describes alternatives available to plants that currently operate under the variance and estimates the national cost of implementing such alternatives. Little justification has been found for removing the 316(a) variance from the CWA.

26112 (ANL/EAIS/CP–78927) **An examination of utility emissions contributions to elevated ozone concentrations in the Chicago area.** Fernau, M.E.; Guziel, K.A.; South, D.W. Argonne National Lab., IL (United States). Environmental Assessment and Information Sciences Div. [1993]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-930647–2: 86. annual meeting and exhibition of the Air and Waste Management Association, Denver, CO (United States), 13-18 Jun 1993). Order Number DE93012852. Source: OSTI; NTIS; INIS GPO Dep.

In order to reduce the pollutant load to the atmosphere and subsequent damaging effects, Titles I and IV of the Clean Air Act Amendments of 1990 (CAAAs) require reductions in emissions of sulfur dioxide (SO_2), nitrogen oxides (NO_x), and volatile organic compounds (VOCs). Title IV is aimed at reducing acidic deposition and requires utilities to reduce SO_2 and NO_x emissions to specified levels. As a consequence of this, many utilities will have to install SO_2 and NO_x control technologies. Title I is concerned with bringing regions into compliance with the National Ambient Air Quality Standards (NAAQS) for the criteria pollutants, among which is ozone (O_3). The NAAQS for O_3 is 120 ppb (parts per billion by volume) hourly average concentration, not to be exceeded four times in three years. O_3 is a secondary pollutant formed in the atmosphere when NO_x and VOCs react together in the presence of sunlight. Utilities are a significant source of NO_x and an unimportant source of VOCs. In the past, O_3 control strategy has focused on reducing VOC emissions because of the possibility that reducing NO_x actually might make O_3 concentrations higher. However, this approach has not worked, perhaps because of underestimation of natural and manmade VOC emissions and transport of O_3 from other regions. Computer modeling has shown that for many highly polluted areas massive NO_x reductions may be necessary in addition to or in place of VOC controls. Utilities are a potential source of these NO_x reductions.

2006 Economic, Industrial, and Business Aspects

Refer also to citation(s) 26446

26113 (ETDE-GB–480) **Report and accounts 1992.** Powergen plc, London (United Kingdom). 1992. 24p. Order Number DE93502647. Source: OSTI; NTIS (US Sales Only); INIS; Available from PowerGen plc, 53 New Bond St., London EC2M 1JJ.

The directors present their report and the audited accounts of PowerGen plc for the financial year ended 29 March 1992. The Company's principal activity is the generation and sale of electricity in England and Wales. The Chairman's Statement and Chief Executive's Review, contained in the Annual Review, report on the development of the business during the financial year and the outlook for the future. They contain information about the Company's research and development activities, its commitment to ensuring that environmental implications for the business are properly identified, assessed and managed, and its arrangements with regard to health and safety and employees' welfare at work. Profit before taxation for the financial year to 29 March 1992 was Pound 359 million (an increase on the restated figure for 1990/91) of Pound 87 million or 32 per cent. After providing for taxation (Pound 117 million), and for payment of the dividend (Pound 72 million), the retained profit for the year amounted to Pound 170 million. (Author)

26114 (RVF–92-11) **Need for an investment subsidy for waste cogeneration plants.** Maardsjoe, O. (Ecoheat AB (Sweden)). Svenska Renhallningsverks-Foereningen, Stockhom (Sweden). Dec 1992. 40p. (In Swedish). Order Number DE93500659. Source: OSTI; NTIS; INIS.

Building of new waste-fueled CHPs has been economically evaluated. Total investment cost have been calculated for plants of three different sizes, 2x15, 2x25, and 2x50 MW thermal power, respectively. The calculations show that the small plants have poor and the large plants mediocre profitability. Better economy can be achieved for the large plants if a higher steam quality than normal is used (120 bar, 540 degree C instead of 40 bar, 400 degree C). The conclusions are that investment subsidies are necessary for building these plants, in particular the small ones. Subsidy levels are estimated according to two principles: Pay-back no later than eight years after commissioning, or covering of deficits until revenues surpasses capital costs. Use of biofuels to level the fluctuations in waste flow, and thus make more efficient use of the plant, can also help the economy of the plant. (8 figs., 15 tabs.).

2007 Legislation and Regulations

Refer also to citation(s) 26111, 26462

21 NUCLEAR POWER REACTORS AND ASSOCIATED PLANTS

Refer also to citation(s) 26256, 26257, 26258, 26259, 28216

26115 (IAEA-TECDOC–700, pp. 49-55) **Decision aid software development for nuclear reactors.** Evrard, J.M. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service d'Etudes des Reacteurs et de Mathematiques Appliquees); Martinez, J.M.; Raymond, P. International Atomic Energy Agency, Vienna (Austria). Apr 1993. (CONF-9209356–: Specialists meeting/workshop on the potential of knowledge based systems in nuclear installations, Erlangen (Germany), 21-25 Sep 1992). In *The potential of knowledge based systems in nuclear installations: Report of a specialists' meeting/workshop held in Erlangen, Germany, 21-25 September 1992.* [97p.] Order Number DE93629675. Source: OSTI; NTIS (US Sales Only); INIS.

The development of new techniques, especially in the field of Artificial Intelligence, makes it possible to design more powerful computerised systems supporting tasks related to the design and operation of nuclear power plants. The potential contribution and perspectives for the integration of such systems depend upon whether the improvement of existing plants, the design of next generation reactors or future projects are concerned. This paper will present four systems which show the state of the art in the field of knowledge-based systems. The first one is related to the automatic generation of accidental procedures dealing with the loss of electrical power supply. The second one aims at assisting the power plant utility in following the technical specifications during maintenance operations. Finally, the last two are designed to help an emergency team to evaluate and to forecast the evaluation of an accidental situation in a nuclear reactor plant. Perspectives for one-line operator assistance are then discussed, as well as the main technical topics which will make possible the design of such systems. We conclude with the difficulties which are encountered upon integration of these tools: their validation and the task sharing between man and machine. (author). 8 refs.

26116 (IAEA-TECDOC–700, pp. 63-75) **The role of neural networks in nuclear power plant safety systems.** Boger, Z. (Israel Atomic Energy Commission, Beersheba (Israel). Nuclear Research Center-Negev). International Atomic Energy Agency, Vienna (Austria). Apr 1993. (CONF-9209356–: Specialists meeting/workshop on the potential of knowledge based systems in nuclear installations, Erlangen (Germany), 21-25 Sep 1992). In *The potential of knowledge based systems in nuclear installations: Report of a specialists' meeting/workshop held in Erlangen, Germany, 21-25 September 1992.* [97p.] Order Number DE93629675. Source: OSTI; NTIS (US Sales Only); INIS.

Neural networks (NN) techniques have been applied in recent years to many systems by researchers in the nuclear power industry, mainly for modeling and sensor validation. Recent results are reviewed, including new directions in applications to control systems, safety analysis, and "virtual" instruments. As new fast learning algorithms become available, large systems may be learned effectively, even with few training examples. The nuclear industry hesitates to include NN in safety related systems, but it seems that the obstacles could be overcome with the demonstration of successful applications, even from other industries. Coupling of full-scale reactor simulators, as fault database generators, with neural networks learning should be explored. The integration of Expert System technology with NN should improve the Validation and Verification tasks, and also help overcome psychological barriers. It may prove that the potential of NN to help operators, compared with the existing and proposed alternatives, outweigh the risks. (author). 58 refs, 2 figs.

2101 Power Reactors, Nonbreeding, Light-Water Moderated, Boiling Water Cooled

Refer also to citation(s) 25640, 25710, 26134, 26136, 26141, 26142, 26145, 26148, 26149, 26150, 26151, 26154, 26169, 26227, 26244, 26246, 26247, 26253, 26342, 26347, 26348, 26351, 26361, 26363, 26370, 26372, 26713

26117 (BNL-NUREG–48969) **Instability due to a two recirculation pump trip in a BWR using RAMONA-4B computer code with 3D neutron kinetics.** Cheng, H.S.; Rohatgi, U.S. Brookhaven National Lab., Upton, NY (United States). [1993]. 7p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-930830–21: National conference and exposition on heat transfer, Atlanta, GA (United States), 8-11 Aug 1993). Order Number DE93015395. Source: OSTI; NTIS; INIS; GPO Dep.

An investigation was made of the potential for thermal-hydraulic instabilities coupled to neutronic feedback in a BWR due to a two recirculation pump trip event using the RAMONA-4B computer code with 3D neutron kinetics. It is concluded that a high-power (100%) and low-flow (75%) initial condition would most likely lead to in-phase density wave oscillations after the tripping of both recirculation pumps, and that RAMONA-4B is capable of predicting such thermal-hydraulic instabilities coupled to neutronic feedback in BWR and in SBWR.

26118 (DTH-AEF-NT–3) **The two-phase friction multiplier factor R and the slip ratio S: A comparison of various correlations.** Oelgaard, P.L. Technical Univ. of Denmark, Lyngby (Denmark). Dept. of Electrophysics. Feb 1993. [30p.] Order Number DE93628296. Source: OSTI; NTIS; INIS.

In this report the theoretical basis for the Lottes-Flinn correlation for the two-phase friction multiplier R is investigated and a less approximative formula for R is derived. The values obtained for R (as a function of pressure and exit void fraction) from these formulas by use of various slip ratio correlations are compared with the R-values obtained by the experimental Martinelli-Nelson and other correlations. It is concluded that while some slip ratio correlations appear to be of rather dubious value, it is not possible from the present comparison to select a best slip ratio correlation or a best two-phase friction multiplier correlation to be used in the computation of boiling water reactors. (au).

26119 (EUR–14043/3) **Assessment of management alternatives for LWR wastes. Volume 3. Description of German scenarios for PWR and BWR wastes.** Santraille, S. (Societe Franco-Americaine de Constructions Atomiques (FRAMATOME), 92 - Courbevoie (France)); Janberg, K.; Geiser, H. Commission of the European Communities, Luxembourg (Luxembourg). 1993. [193p.] Contract FI1W/0130-C. Source: OSTI; NTIS (US Sales Only); INIS.

This report deals with the description of a management route for PWR waste relying to a certain extent on German practices in this particular area. This description, which aims at providing input data for subsequent cost evaluation, includes all management steps which are usually implemented for solid, liquid and gaseous wastes from their production up to the interim storage of the final waste products. This study is part of an overall theoretical exercise aimed at evaluating a selection of management routes for PWR and BWR wastes based on economical and radiological criteria.

26120 (IAEA-TECDOC–697, pp. 75-81) **The effect of fuel pellet variants on fission gas release following power ramps.**

Howl, D.A. (British Nuclear Fuels Ltd., Springfields (United Kingdom)); Topliss, I.R. International Atomic Energy Agency, Vienna (Austria). Apr 1993. (CONF-9204252–: Technical committee meeting on fission gas release and fuel rod chemistry related to extended burnup, Pembroke (Canada), 28 Apr - 1 may 1992). In *Fission gas release and fuel rod chemistry related to extended burnup: Proceedings of a technical committee meeting held in Pembroke, Ontario, Canada, 28 April - 1 May 1992.* [235p.] Order Number DE93628297. Source: OSTI; NTIS (US Sales Only); INIS.

Results are presented of fission gas release inferred from on-line rod internal pressure measurements for several fuel variants which were subjected to a power ramp after irradiation to 18 MWd/kgU. The variants were standard and large grain solid fuel, and niobia-doped and undoped large grain annular fuel. The rates of fission product release, which did not saturate in 20-70 days following power ramps to 38-45 kW/m, are well predicted by the ENIGMA fuel performance code. The experiments also included on-line measurements of rod diameter, enabling the evolution and relaxation of ridging to be determined. Examples are given in the paper. These experiments were jointly funded by British Nuclear Fuels plc and the Electric Power Research Institute. (author). 2 refs, 15 figs, 1 tab.

26121 (IAEA-TECDOC–697, pp. 103-110) **Impact of systematic stoichiometry differences among BWR rods on fission gas release.** Grapengiesser, B. (ABB Atom AB, Vaesteraas (Sweden)); Schrire, D. International Atomic Energy Agency, Vienna (Austria). Apr 1993. (CONF-9204252–: Technical committee meeting on fission gas release and fuel rod chemistry related to extended burnup, Pembroke (Canada), 28 Apr - 1 may 1992). In *Fission gas release and fuel rod chemistry related to extended burnup: Proceedings of a technical committee meeting held in Pembroke, Ontario, Canada, 28 April - 1 May 1992.* [235p.] Order Number DE93628297. Source: OSTI; NTIS (US Sales Only); INIS.

In this paper an approach for the explanation of high fission gas release (FGR) found in rods towards the control rod corner of the assembly is suggested, implying that differences in initial enrichment by a sequence of physical phenomena have a strong impact on gas diffusion constant and FGR. 8 refs, 14 figs.

26122 (IAEA-TECDOC–697, pp. 111-118) **Rim effect observations from the Third Riso Fission Gas Project.** Kjaer-Pedersen, N. (S. Levy Inc., Campbell, CA (United States)). International Atomic Energy Agency, Vienna (Austria). Apr 1993. (CONF-9204252–: Technical committee meeting on fission gas release and fuel rod chemistry related to extended burnup, Pembroke (Canada), 28 Apr - 1 may 1992). In *Fission gas release and fuel rod chemistry related to extended burnup: Proceedings of a technical committee meeting held in Pembroke, Ontario, Canada, 28 April - 1 May 1992.* [235p.] Order Number DE93628297. Source: OSTI; NTIS (US Sales Only); INIS.

The Third Riso Fission Gas Release Project was completed early 1991. The project was sponsored by a group of participants representing the world-wide nuclear industrial and scientific community. The analysis presented in this paper is based on an original data analysis sponsored by the Swedish Nuclear Inspectorate. This data analysis aimed at interpreting the temperature and fission gas release measurements of the project. 9 refs.

26123 (STUK-B-YTO–101) **Operation of Finnish nuclear power plants: Quarterly report 2nd quarter, 1992.** Tossavainen, K. (ed.). Finnish Centre for Radiation and Nuclear Safety (STUK), Helsinki (Finland). Dec 1992. [28p.] Order Number DE93629703. Source: OSTI; NTIS; INIS.

Published also in Finnish as report number STUK-B-YTO–100.

The Finnish nuclear power plant units Loviisa 1 and 2 as well TVO I and II were in operation for almost the whole second quarter of 1992. Longer breaks in production were caused by the annual maintenance of the TVO plant units. The load factor was 87.4 %. At TVO I it was detected during the annual maintenance outage when removing nuclear fuel assemblies from the reactor that one assembly had been loaded into the reactor in an incorrect manner during the previous year's annual maintenance: the assembly was slightly higher than the other assemblies. The water cooling the nuclear fuel partly by-passed the fuel assembly and the coolant flow proper passing through the assembly was below design. The fuel assembly's cooling had been sufficient during the whole operating cycle but could have essentially deteriorated during certain transients with the danger of consequent damage to some fuel rods. On the International Nuclear Event Scale the event is classified as level 1. Other events in this quarter which are classified on the International Nuclear Event Scale were level 0/below scale on the scale.

26124 (VTT-TIED–1411) **Simulation of fires based on flow calculation.** Huhtanen, R. (Technical Research Centre of Finland, Espoo (Finland). Nuclear Engineering Lab.); Jacobson, T. Technical Research Centre of Finland, Espoo (Finland). 1992. [50p.] (In Finnish). Order Number DE93629704. Source: OSTI; NTIS; INIS.

The fire simulation based on flow calculation is described in the publication, and the calculated result is compared with the results obtained from fire tests. The tests have been made in Germany in a nuclear power plant removed from service. The simulation describes the flow field of the entire building, the main features of the construction effecting on it and the edge conditions. The fire is described as a given source, the value of which varies as a function of time. Heat transfer into the constructions is described using a separate heat transfer program. The result obtained from calculation describes the flow and temperature fields formed in a fire generally correctly. Due to the used sparse calculation network the results contain locally large deviations. The discrete-transfer radiation calculation method used for calculation of burning and heat transfer, and testing of it are described in the appendix. The method describes the heat radiation propagating diagonally to the calculation network better than the six-flux method used before.

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Refer also to citation(s) 25640, 25708, 25710, 25879, 26122, 26123, 26169, 26227, 26246, 26253, 26267, 26269, 26342, 26343, 26347, 26354, 26355, 26357, 26358, 26360, 26362, 26363, 26366, 26367, 26368, 26369, 26371, 26713

26125 (CEA-CONF–11288) **Increasing knowledge of stress corrosion cracking in PWR steam generator tubes combining Eddy current testing and nondestructive analysis of mock-ups.** David, B. (CEA Centre d'Etudes de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Technologie des Materiaux); Cherpentier, C.; Daret, J.; Birac, C. CEA Centre d'Etudes de Fontenay-aux-Roses, 92 (France). Service de la Corrosion, d'Electrochimie et Chimie des Fluides. 1990. [4p.] (CONF-900649–: International conference on non-destructive evaluation (NDE)in the nuclear industry, Glasgow (United Kingdom), 4-7 Jun 1990). Order Number DE93628301. Source: OSTI; NTIS (US Sales Only); INIS.

Cooperation between two CEA research laboratories has served to combine nondestructive testing with destructive analyses on problems set within the framework of the Safety analysis. Network microcracking in roll expansion and cracking under support plates of alloy 600 tubes were accordingly investigated, by combining original methods of defect production in laboratory with fine destructive and nondestructive analysis.

26126 (CEA-DES–110) **International technical assistance example. Consortium action in Bulgaria.** Mattei, J.M. (CEA Centre d'Etudes de Fontenay-aux-Roses, 92 (France). Inst. de Protection et de Surete Nucleaire); Milhem, J.L.; Heuser, F.W.; Kelm, P. CEA Centre d'Etudes de Fontenay-aux-Roses, 92 (France). Dept. d'Evaluation de Surete. Mar 1993. [11p.] (In French). (CONF-921282–: Conference on WWERs reactor safety, Paris (France), 9 Dec 1992). Order Number DE93631497. Source: OSTI; NTIS (US Sales Only); INIS.

The safety status achieved last year at the Kozloduy Nuclear Power Plant (NPP) and the capability of the Bulgarian Nuclear Safety Authority (BNSA) to assess the safety of the plant and the adequacy of proposed improvements have been matters of international concern. However, the Kozloduy NPP contributes 35-40 per cent of the electrical generating capacity in Bulgaria. For further operation of the plants, it is therefore, essential that safety is improved. In july 1991, the Commission of the European Communities (CEC) instituted a Six Months Emergency Action Programme

for Bulgaria under the PHARE regional nuclear safety programme. The programme consisted of three parts: - an industrial emergency programme supporting the utility of the Kozloduy NPP, - a study to evaluate Bulgaria's electricity needs, - technical assistance for reinforcement of the Bulgarian Nuclear Safety Authority. For the third part, complementary to the industrial emergency programme carried out by the WANO (World Association of Nuclear Operators), a Consortium of expert institutions and regulatory from EC member states was established by CEC for assistance to BNSA. The Consortium consisted of: - Institut de Protection et de Surete Nucleaire (IPSN), France, technical support of the French regulatory body, - Gesellschaft fur Anlagen und Reaktorsicherheit (GRS) mbH, Germany, an organization in safety engineering, technical support of governmental regulatory body, - AIB-Vincotte Nuclear (AVN), Belgium, the organization authorized by the Belgian Government for licensing and inspection of nuclear power plants, - UK Atomic Energy Authority (AEA Technology), an independent UK Government owned nuclear R and D and consultancy organization, - Nuclear Installations Inspectorate (NII) of the Health and Safety Executive, United Kingdom, the nuclear regulatory body for the United Kingdom.

26127 (CONF-9210209–3) **Large-scale thermal-shock experiments with clad and unclad steel cylinders.** Cheverton, R.D. Oak Ridge National Lab., TN (United States). [1992]. 21p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC05-84OR21400. From Organization for Economic Co-Operation Development/International Atomic Energy Agency/Commission of Safety Nuclear Installations (OECD/IAEA/CSNI) joint international specialists meeting on fracture mechanics verification by large scale testing; Knoxv Order Number DE93015447. Source: OSTI; NTIS; INIS; GPO Dep.

Flaw behavior trends associated with pressurized-thermal-shock (PTS) loading of pressurized-water-reactor pressure vessels have been under investigation at the Oak Ridge National Laboratory for nearly 20 years. During that time, twelve thermal-shock experiments with thick-walled (152 mm) steel cylinders were conducted as a part of the investigations. The first eight experiments were conducted with unclad cylinders initially containing shallow (8–19 mm) two-dimensional and semicircular inner-surface flaws. These experiments demonstrated, in good agreement with linear elastic fracture mechanics, crack initiation and arrest, a series of initiation/arrest events with deep penetration of the wall, long crack jumps, arrest with the stress intensity factor (K_I) increasing with crack depth, extensive surface extension of an initially short and shallow (semicircular) flaw, and warm prestressing with $K_I \leq 0$. The remaining four experiments were conducted with clad cylinders containing initially shallow (19–24 mm) semielliptical subclad and surface flaws at the inner surface. In the first of these experiments one of six equally spaced (60°) "identical" subclad flaws extended nearly the length of the cylinder (1,220 mm) beneath the cladding (no crack extension into the cladding) and nearly 50% of the wall, radially. For the final experiment, four of the semielliptical subclad flaws that had not propagated previously were converted to surface flaws, and they experienced extensive extension beneath the cladding with no cracking of the cladding. Information from this series of thermal-shock experiments is being used in the evaluation of the PTS issue.

26128 (DOE/SF/19682–T1-Vol.2) **DOE plutonium disposition study: Pu consumption in ALWRs: Volume 2, Final report.** ABB/Combustion Engineering, Inc., Windsor, CT (United States). 15 May 1993. 285p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-93SF19682. Order Number DE93013226. Source: OSTI; NTIS; INIS; GPO Dep.

The Department of Energy (DOE) has contracted with Asea Brown Boveri-Combustion Engineering (ABB-CE) to provide information on the capability of ABB-CE's System 80 + Advanced Light Water Reactor (ALWR) to transform, through reactor burnup, 100 metric tonnes (MT) of weapons grade plutonium (Pu) into a form which is not readily useable in weapons. This information is being developed as part of DOE's Plutonium Disposition Study, initiated by DOE in response to Congressional action. This document Volume 2, provides a discussion of: Plutonium Fuel Cycle; Technology Needs; Regulatory Considerations; Cost and Schedule Estimates; and Deployment Strategy.

26129 (EDF–93-NB-00005) **Development of RCM methodology and tools for EDF nuclear power plants.** Jacquot, J.P.; Bouchet, J.L.; Despujols, A.; Dewailly, J.; Martin-Mattei, C. Electricite de France (EDF), 92 - Clamart (France). Jun 1992. [15p.] (In French). Order Number DE93631499. Source: OSTI; NTIS (US Sales Only); INIS.

This paper outlines the development of Reliability-Centered Maintenance procedures in the nuclear power industry. It presents the pilot study undertaken by EDF in the overall framework of its 'OMF' (RCM) project, as well as the potential for further improving and enriching analytical methods. Lastly, it gives the prospects for the future design of an 'OMF' workstation.

26130 (EDF–93-NJ-00002(Rev.)) **Compiling models into real-time systems.** Dormoy, J.L.; Cherriaux, F.; Ancelin, J. Electricite de France (EDF), 92 - Clamart (France). Aug 1992. [14p.] (In French). Order Number DE93631500. Source: OSTI; NTIS (US Sales Only); INIS.

This paper presents an architecture for building real-time systems from models, and model-compiling techniques. This has been applied for building a real-time model-based monitoring system for nuclear plants, called KSE, which is currently being used in two plants in France. We describe how we used various artificial intelligence techniques for building it: a model-based approach, a logical model of its operation, a declarative implementation of these models, and original knowledge-compiling techniques for automatically generating the real-time expert system from those models. Some of those techniques have just been borrowed from the literature, but we had to modify or invent other techniques which simply did not exist. We also discuss two important problems, which are often underestimated in the artificial intelligence literature: size, and errors. Our architecture, which could be used in other applications, combines the advantages of the model-based approach with the efficiency requirements of real-time applications, while in general model-based approaches present serious drawbacks on this point.

26131 (EGG-M–92494) **Engineering reliability in design phase: An application to AP-600 reactor passive safety system.** Majumdr, D. (USDOE Idaho Field Office, Idaho Falls, ID (United States)); Siahpush, A.S.; Hills, S.W. EG and G Idaho, Inc., Idaho Falls, ID (United States). [1992]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. (CONF-921003–11: International conference on design and safety of advanced nuclear power plants, Tokyo (Japan), 25-28 Oct 1992). Order Number DE93013661. Source: OSTI; NTIS; INIS; GPO Dep.

A computerized reliability enhancement methodology is described that can be used at the engineering design phase to help the designer achieve a desired reliability of the system. It can take into account the limitation imposed by a constraint such as budget, space, or weight. If the desired reliability of the system is known, it can determine the minimum reliabilities of the components, or how many redundant components are needed to achieve the desired reliability. This methodology is applied to examine the Automatic Depressurization System (ADS) of the new passively safe AP-600 reactor. The safety goal of a nuclear reactor dictates a certain reliability level of its components. It is found that a series parallel valve configuration instead of the parallel-series configuration of the four valves in one stage would improve the reliability of the ADS. Other valve characteristics and arrangements are explored to examine different reliability options for the system.

26132 (EUR–14043/1) **Assessment of management alternatives for LWR wastes. Volume 1. Main achievements of the joint study.** Glibert, R.C. (Belgatom SA, Brussels (Belgium)). Commission of the European Communities, Luxembourg (Luxembourg). 1993. [122p.] Contract FI1W/0124-B. Source: OSTI; NTIS (US Sales Only); INIS.

This report deals with the main achievements of a joint theoretical study aimed at evaluating a selection of management routes for LWR wastes, relying to a certain extent on national practices in this particular area, on the basis of economical and radiological criteria. All individual intermediate steps entering a management route, from radioactive-wastes production up to their disposal in

near-surface sites or in a deep repository, have been identified, described and cost-evaluated throughout the study. The radiological impact assessment comprises estimates of both individual and collective doses resulting from normal discharges of radioactive effluents and from disposal of radioactive waste products in near-surfaces sites. All specific data concerning the description of the different management routes considered as well as the methodology applied to evaluate cost and radiological impact are detailed in the subsequent volumes of the series (Volumes 2 to 8).

26133 (EUR–14043/2) **Assessment of management alternatives for LWR wastes. Volume 2. Description of a French scenario for PWR waste.** Saulieu, E. de (Societe Generale pour les Techniques Nouvelles (SGN), 78 - Saint-Quentin-en-Yvelines (France)); Chary, C. Commission of the European Communities, Luxembourg (Luxembourg). 1993. [99p.] Contract FI1W/0132-F. Source: OSTI; NTIS (US Sales Only); INIS.

This report deals with the description of a management route for PWR waste relying to a certain extent on French practices in this particular area. This description, which aims at providing input data for subsequent cost evaluation, includes all management steps which are usually implemented for solid, liquid and gaseous wastes from their production up to the interim storage of the final waste products. This study is part of an overall theoretical exercise aimed at evaluating a selection of management routes for LWR waste based on economical and radiological criteria.

26134 (IAEA-TECDOC–697, pp. 25-31) **Fission gas release and fuel temperature during power transients in water reactor fuel at extended burnup.** Knudsen, P. (Risoe National Lab., Roskilde (Denmark)); Bagger, C.; Mogensen, M.; Toftegaard, H. International Atomic Energy Agency, Vienna (Austria). Apr 1993. (CONF-9204252–: Technical committee meeting on fission gas release and fuel rod chemistry related to extended burnup, Pembroke (Canada), 28 Apr - 1 may 1992). In *Fission gas release and fuel rod chemistry related to extended burnup: Proceedings of a technical committee meeting held in Pembroke, Ontario, Canada, 28 April - 1 May 1992.* [235p.] Order Number DE93628297. Source: OSTI; NTIS (US Sales Only); INIS.

Data on transient fission gas release and fuel temperature have been obtained with refabricated test fuel pins that were instrumented with pressure transducers and centre line fuel thermocouples. Major test variables were: fuel type, burnup, transient power history, fill gas, refabricated/unopened fuel segments. The previously irradiated test fuels (15-48 MWd/kgU) were provided by ANF, GE and Riso. A total of 15 transient tests were performed. The maximum power was usually around 350-400 W/cm. The hold time at maximum power ranged from a few hours to six days. The test fuels were characterized extensively after base irradiation and after transient testing. These investigations were carried out in the framework of the Third Riso Fission Gas Project. The paper presents an overview of the experiments and of the major results thus obtained. (author). 4 refs, 7 figs, 3 tabs.

26135 (IAEA-TECDOC–697, pp. 32-37) **Fission gas release below 20 kWm^{-1} in transient tested water reactor fuel at extended burnup.** Mogensen, M. (Risoe National Lab., Roskilde (Denmark)); Bagger, C.; Toftegaard, H.; Knudsen, P.; Walker, C.T. International Atomic Energy Agency, Vienna (Austria). Apr 1993. (CONF-9204252–: Technical committee meeting on fission gas release and fuel rod chemistry related to extended burnup, Pembroke (Canada), 28 Apr - 1 may 1992). In *Fission gas release and fuel rod chemistry related to extended burnup: Proceedings of a technical committee meeting held in Pembroke, Ontario, Canada, 28 April - 1 May 1992.* [235p.] Order Number DE93628297. Source: OSTI; NTIS (US Sales Only); INIS.

One of the fuel types transient tested in the Third Riso Fission Gas Project released 5-7% of its fission gas in the power range 3.6 to 17 kWm^{-1} during the ramp. Isotopic analysis revealed that compared with fission gas released at powers above 30 kWm^{-1} this gas contained lower concentrations of ^{83}Kr and ^{131}Xe. This suggests that it had left the UO_2 matrix during the base irradiation and had been for a long period isolated from the rest of the gas generated. It is proposed, therefore, that the gas released at low power had emanated from large pores, which were vented when the fuel cracked during the ramp. (author). 9 refs, 5 figs, 5 tabs.

26136 (IAEA-TECDOC–697, pp. 38-44) **Experimental assessment of a temperature threshold for thermally induced fission gas release in transient tested water reactor fuel with extended burnup.** Bagger, C. (Risoe National Lab., Roskilde (Denmark)); Mogensen, M. International Atomic Energy Agency, Vienna (Austria). Apr 1993. (CONF-9204252–: Technical committee meeting on fission gas release and fuel rod chemistry related to extended burnup, Pembroke (Canada), 28 Apr - 1 may 1992). In *Fission gas release and fuel rod chemistry related to extended burnup: Proceedings of a technical committee meeting held in Pembroke, Ontario, Canada, 28 April - 1 May 1992.* [235p.] Order Number DE93628297. Source: OSTI; NTIS (US Sales Only); INIS.

In-pile measurements of gas release and fuel temperature in The Third Riso Fission Gas Project show that onset of fission gas release during mild power transients takes place at a fuel temperature close to 1200 deg. C. Evaluation of PIE results together with the temperature measurements confirms the temperature level and indicates that the onset temperature is independent of fuel type, burnup and hold time. The radial location of the 1200 deg. C isotherm moves towards the rim with increasing burnup and constant linear power, assumably because of formation of a thermal barrier at the rim. Consequently the fractional fission gas release increases with burnup. For one of the fuel types investigated fission gas release is complete after 42h at 1525 deg. C. The results suggest that the radial temperature distribution changes gradually from a parabola toward a square with increasing burnup. (author). 7 refs, 7 figs, 2 tabs.

26137 (IAEA-TECDOC–697, pp. 63-67) **Fission gas release of high burnup fuel.** Manzel, R. (Siemens AG Unternehmensbereich KWU, Erlangen (Germany)); Bodmer, R.P.; Bart, G. International Atomic Energy Agency, Vienna (Austria). Apr 1993. (CONF-9204252–: Technical committee meeting on fission gas release and fuel rod chemistry related to extended burnup, Pembroke (Canada), 28 Apr - 1 may 1992). In *Fission gas release and fuel rod chemistry related to extended burnup: Proceedings of a technical committee meeting held in Pembroke, Ontario, Canada, 28 April - 1 May 1992.* [235p.] Order Number DE93628297. Source: OSTI; NTIS (US Sales Only); INIS.

Fission gas release data are presented for PWR fuel rods with an enrichment of 3.8 w/o to 4.2 w/o U-235 designed for high burnup. These fuel rods were operated up to 4 cycles under realistic power conditions to target burnups of 54 MWd/kgU. As expected, the fission gas release of fuel rods of higher enrichment was generally higher compared to that of fuel rods of lower enrichment. However, whilst the fractional fission gas release of lower enriched fuel rods shows a tendency to increase with increasing burnup, the fractional release of higher enriched rods passes through a maximum at intermediate burnups, and then shows a tendency to saturate. The highest fractional fission gas release of about 10% was measured on fuel rods with large initial diametrical gaps between fuel and cladding, the lowest release values were found on fuel rods with small initial diametrical gap. These fuel rods showed a behaviour similar to that of the lower enriched fuel rods. The fission gas released in general originates from the center region of the pellets. The diameter of this region is dependent on fuel center temperature. However, microstructural examinations do also show an increase with increasing burnups in spite of decreasing fuel temperatures. The microstructural features observed can be correlated with distinct steps in fission gas release. (author). 5 refs, 6 figs.

26138 (IAEA-TECDOC–697, pp. 68-75) **Fission gas release enhancement at extended burnup: Experimental evidence from French PWR irradiation.** Forat, C. (Fragema/Framatome Fuel Div., Lyon (France)); Blanpain, B.; Kapusta, B.; Guedeney, P.; Permezel, P. International Atomic Energy Agency, Vienna (Austria). Apr 1993. (CONF-9204252–: Technical committee meeting on fission gas release and fuel rod chemistry related to extended burnup, Pembroke (Canada), 28 Apr - 1 may 1992). In *Fission gas release and fuel rod chemistry related to extended burnup: Proceedings of a technical committee meeting held in Pembroke, Ontario, Canada, 28 April - 1 May 1992.* [235p.] Order Number DE93628297. Source: OSTI; NTIS (US Sales Only); INIS.

Two families of 17x17 Fragema assemblies were irradiated for five cycles in French PWR; post-irradiation examinations performed

on rods extracted after each cycle showed interesting features linked to the different power histories the two families experienced. Particularly, the evolution of the fuel microstructure made it possible to single out the contribution of the athermal process, including the "rim effect", and the thermal process. The development of "high burnup" realistic models needs a correct evaluation of the thermal conductivity deterioration and the lowering of the gas release threshold as burnup proceeds. (author). 8 refs, 6 figs.

26139 (IAEA-TECDOC–697, pp. 91-98) **Fission gas release from high burnup PWR fuels under transient conditions.** Kanazawa, H. (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment); Sasajima, H.; Homma, K.; Ichise, K.; Fujishiro, T.; Yamahara, T. International Atomic Energy Agency, Vienna (Austria). Apr 1993. (CONF-9204252–: Technical committee meeting on fission gas release and fuel rod chemistry related to extended burnup, Pembroke (Canada), 28 Apr - 1 may 1992). In *Fission gas release and fuel rod chemistry related to extended burnup: Proceedings of a technical committee meeting held in Pembroke, Ontario, Canada, 28 April - 1 May 1992.* [235p.] Order Number DE93628297. Source: OSTI; NTIS (US Sales Only); INIS.

Extensive research programs on fission gas release behavior under accidental conditions are in progress at Japan Atomic Energy Research Institute (JAERI). In this paper, the results obtained in experimental studies, including annealing tests, and in-pile experiments to simulate Reactivity Initiated Accident (RIA) conditions, are described and discussed. (author). 9 refs, 10 figs, 1 tab.

26140 (IAEA-TECDOC–697, pp. 98-103) **Fission product behaviour and fuel rod chemistry at extended burnup: Results, models and programmes of analytical experiments carried out at the CEA, Grenoble.** Charles, M. (CEA Centre d'Etudes de Grenoble, 38 (France)); Caillot, L.; Dehaudt, P.; Lemaignan, C. International Atomic Energy Agency, Vienna (Austria). Apr 1993. (CONF-9204252–: Technical committee meeting on fission gas release and fuel rod chemistry related to extended burnup, Pembroke (Canada), 28 Apr - 1 may 1992). In *Fission gas release and fuel rod chemistry related to extended burnup: Proceedings of a technical committee meeting held in Pembroke, Ontario, Canada, 28 April - 1 May 1992.* [235p.] Order Number DE93628297. Source: OSTI; NTIS (US Sales Only); INIS.

Of the analytical experiments carried out at CEA to study fuel behaviour at high burnups, special mention should be made of the study of the effects of moderate transients on fission gas release (importance of cracking associated with power variations), and SEM examination of fracture surface of various fuels (analysis of bubble populations and precipitates of associated metallic fission products). Several factors must be considered when analysing the results: radial specific power profile and its thermal effect, fission gas creation, oxygen balance, density and open porosity, gaseous swelling. This paper describes the principle of various tools (calculations or experiments) used to obtain information on all these points. Finally, a brief discussion is given of the study programmes relating to the effect of O/M ratio on fuel behaviour and to the major problem of caesium retention. (author). 11 refs, 4 figs.

26141 (IAEA-TECDOC–697, pp. 118-123) **Experimental techniques and results related to high burn-up investigations at the OECD Halden Reactor Project.** Wiesenack, W. (OECD Halden Reactor Project, Halden (Norway)). International Atomic Energy Agency, Vienna (Austria). Apr 1993. (CONF-9204252–: Technical committee meeting on fission gas release and fuel rod chemistry related to extended burnup, Pembroke (Canada), 28 Apr - 1 may 1992). In *Fission gas release and fuel rod chemistry related to extended burnup: Proceedings of a technical committee meeting held in Pembroke, Ontario, Canada, 28 April - 1 May 1992.* [235p.] Order Number DE93628297. Source: OSTI; NTIS (US Sales Only); INIS.

Investigations of phenomena associated with extended or high burn-up comprise a considerable part of the fuel and materials research programme carried out at the OECD Halden Reactor Project, reflecting the interests and priorities of the nuclear industry in this area. For this purpose, sensors, re-instrumentation techniques, irradiation rigs and data evaluation methods have been developed and successfully applied which allow tests to be conducted at extended burn-up with high data quality. Re-instrumentation of base-irradiated fuel rods (50 MWd/kgU) with pressure transducers has been carried out with several rods, which were then subjected to high power, to study fission gas release. The results as well as those from another high burn-up test confirm the empirical fission gas release threshold developed at Halden, which predicts the onset of FGR to be about 1100 deg. C at this burn-up. The related interlinkage-resintering effects can be studied in special assemblies allowing sweep-out and analysis of fission products. Comprehensive investigations of fuel temperature data suggest a gradual degradation of UO_2 thermal conductivity with burn-up. A special experiment is presently being irradiated to burn-up beyond 60 MWd/kgU, where the accuracy of temperature measurements is maintained by utilising expansion thermometers, insensitive to irradiation induced decalibration. A preliminary evaluation of the temperature increase points to a UO_2 conductivity degradation of 35% at 50 MWd/kgUO_2 and 600 deg. C. (author). 5 refs, 5 figs.

26142 (IAEA-TECDOC–697, pp. 124-130) **Review of Studsvik's international fuel R and D projects.** Grounes, M. (Studsvik Nuclear, Nykoeping (Sweden)); Djurle, S.; Lysell, G.; Mogard, H. International Atomic Energy Agency, Vienna (Austria). Apr 1993. (CONF-9204252–: Technical committee meeting on fission gas release and fuel rod chemistry related to extended burnup, Pembroke (Canada), 28 Apr - 1 may 1992). In *Fission gas release and fuel rod chemistry related to extended burnup: Proceedings of a technical committee meeting held in Pembroke, Ontario, Canada, 28 April - 1 May 1992.* [235p.] Order Number DE93628297. Source: OSTI; NTIS (US Sales Only); INIS.

Since 1975, a series of international fuel R and D projects, primarily addressing the PCI/SSC failure phenomenon have been conducted under the management of Studsvik Nuclear. These projects have been pursued under the sponsorship of different groups of fuel vendors, nuclear power utilities, national R and D organizations and, in some cases, licensing authorities in Europe, Japan and the U.S. In most of the projects the clad failure occurrence was studied under power ramp conditions utilizing the special ramp test facilities of the R2 test reactor. The current projects are not limited to PCI/SCC studies but some of them also include other aspects of fuel performance, such as end-of-life rod overpressure. An overview of the nine projects hat have been completed and six of the projects that are currently in progress or planned is given. During the late 1970's and 1980's the series of international ramp projects branched out in two directions. One series was initially concentrated on the PCI (Pellet-Cladding-Interaction) phenomena under normal operational conditions in different types of BWR and PWR fuel rods subjected to increased burn-up under normal operational conditions. These projects were in a broad sense aimed at decreasing the fuel costs by increases in fuel utilization and reactor availability. The other series was concentrated on more safety-oriented issues, aimed at providing data for fuel-related safety considerations. The first-mentioned series includes the INTER-RAMP, OVER-RAMP, DEMO-RAMP I, SUPER-RAMP, SUPER-RAMP EXTENSION, SUPER-RAMP II/9x9 and SUPER-RAMP III projects. The second series includes the INTER-RAMP, DEMO-RAMP II, TRANS-RAMP I, TRANS-RAMP II, TRANS-RAMP III and TRANS-RAMP IV projects. Furthermore information is also given on the ROPE I, ROPE II and DEFEX projects. (author). 16 refs, 2 tabs.

26143 (IAEA-TECDOC–697, pp. 130-133) **Methodology of in-pile experiments including experimental studies of WWER-1000 refabricated fuels at the MIR research reactor.** Bibilashvili, Yu.K. (Vsesoyuznyj Nauchno-Issledovatel'skij Inst. Neorganicheskikh Materialov, Moscow (Russian Federation)); Novikov, V.V.; Grachev, A.V.; Smirnov, V.P.; Smirnov, A.V. International Atomic Energy Agency, Vienna (Austria). Apr 1993. (CONF-9204252–: Technical committee meeting on fission gas release and fuel rod chemistry related to extended burnup, Pembroke (Canada), 28 Apr - 1 may 1992). In *Fission gas release and fuel rod chemistry related to extended burnup: Proceedings of a technical committee meeting held in Pembroke, Ontario, Canada, 28 April - 1 May 1992.* [235p.] Order Number DE93628297. Source: OSTI; NTIS (US Sales Only); INIS.

This paper gives some indications on the programme of reirradiation of WWER fuel which has been initiated in the experimental reactor MIR. It gives also a description of the process used for refabrication of fuel rods from power reactors. (author).

26144 (IAEA-TECDOC–697, pp. 133-142) **Some experimental results of investigations on the nuclide composition and burnup fraction of WWER-1000 standard fuel.** Smirnov, A.V. (Nauchno-Issledovatel'skij Inst. Atomnykh Reaktorov, Dimitrovgrad (Russian Federation)); Chetverikov, A.P.; Novikov, V.V.; Proselkov, V.N. International Atomic Energy Agency, Vienna (Austria). Apr 1993. (CONF-9204252–: Technical committee meeting on fission gas release and fuel rod chemistry related to extended burnup, Pembroke (Canada), 28 Apr - 1 may 1992). In *Fission gas release and fuel rod chemistry related to extended burnup: Proceedings of a technical committee meeting held in Pembroke, Ontario, Canada, 28 April - 1 May 1992.* [235p.] Order Number DE93628297. Source: OSTI; NTIS (US Sales Only); INIS.

Fission and technological gases release into the free fuel rod volume has been measured by means of μ-spectroscopy and mass-spectroscopy. Fuel rods for examination were taken from fuel assemblies with burnups ranging from 20 to 50 MW.d/Kg U. It was found that the amount of fission gas release for intact fuel rods is not significant, e.g. the share of released Kr-85 has no exceeded 2.5%. In some cases the increased fission gas release was observed for defected fuel rods. With the use of irradiation history data, information on fuel rod design and results of fuel rod parameters measurements in hot cells, calculations of fission gas release into rod free volume were carried out. Results of calculations and measurements were compared. (author). 1 ref., 11 figs, 5 tabs.

26145 (IAEA-TECDOC–697, pp. 145-153) **Hot cell fission gas release studies on UO_2.** Coquerelle, M. (Commission of the European Communities, Karlsruhe (Germany). European Inst. for Transuranium Elements); Bottomley, D. International Atomic Energy Agency, Vienna (Austria). Apr 1993. (CONF-9204252–: Technical committee meeting on fission gas release and fuel rod chemistry related to extended burnup, Pembroke (Canada), 28 Apr - 1 may 1992). In *Fission gas release and fuel rod chemistry related to extended burnup: Proceedings of a technical committee meeting held in Pembroke, Ontario, Canada, 28 April - 1 May 1992.* [235p.] Order Number DE93628297. Source: OSTI; NTIS (US Sales Only); INIS.

UO_2 fuels irradiated at burn-up between 30 and 58 GWd/t and at average linear power ranging from 35 to 20 KWm^{-1} have been investigated in the α,γ laboratory at the Institute for Transuranium Elements. The aim of this study was to determine the influence of increasing burn-up on fission gas release and the relationship between gas release and the fuel microstructure. A first study was undertaken by analysing fuel irradiated in power reactors and the results were reported at an IAEA technical meeting held in Studsvik in 1990. Furthermore, an additional programme was developed aiming at a better understanding of the influence of burn-up, fuel grain size, oxygen potential and temperature on fission gas release. Within the frame of this research our Institute carried out annealing tests in hot cells as part of the Research Programme of the Commission of the European Communities and of the international project High Burn-up Chemistry managed by Belgonucleaire. In these experiments the release of ^{85}Kr is measured during the annealing of irradiated UO_2 samples under H_2O:H_2=1:10, He/2%H_2, and CO_2:CO=10:1 atmospheres. The fuel restructuring as a consequence of the annealing was analysed by optical microscopy and SEM. The analysed fuels were provided by three European nuclear fuel manufacturers: KWU-Siemens, BN and ASEA-ABB. At the present time this study gives qualitative kinetic information on the influence of the different parameters chosen. The results support the view that an increase of the fission gas diffusion rate is caused by increasing burn-up and by annealing under oxidic atmospheres and by decreasing fuel grain size. (author). 3 refs, 10 figs, 2 tabs.

26146 (IAEA-TECDOC–697, pp. 172-176) **Intergranular fission gas bubbles and solid precipitates in UO_2 irradiated at high burnup in various conditions.** Charles, M. (CEA Centre d'Etudes de Grenoble, 38 (France)); Eminet, G.; Lemaignan, C. International Atomic Energy Agency, Vienna (Austria). Apr 1993. (CONF-9204252–: Technical committee meeting on fission gas release and fuel rod chemistry related to extended burnup, Pembroke (Canada), 28 Apr - 1 may 1992). In *Fission gas release and fuel rod chemistry related to extended burnup: Proceedings of a technical committee meeting held in Pembroke, Ontario, Canada, 28 April - 1 May 1992.* [235p.] Order Number DE93628297. Source: OSTI; NTIS (US Sales Only); INIS.

With a view to gaining a better understanding of fission gas release mechanisms at high burnups, the microstructures of three types of nuclear fuel of initial density close to 10.4 $g.cm^{-3}$ were studied: spheres of 1 mm diameter irradiated up to 20 GWd/THM at 900, 1200 and 1500 deg. C, pellets of PWR type irradiated to 22 GWd/THM, with centre-line temperature of the order of 1500 deg. C, and PWR pellets irradiated to 35 GWd/THM in a power reactor and then subjected to a number of transients between 200 and 300 $W.cm^{-1}$ in an experimental reactor. SEM examination of fracture surfaces of these various fuels shows that, below 900 deg. C, no bubbles are visible. At 1200 deg. C, the nucleation of intergranular bubbles is clearly apparent, accompanied by metallic precipitates. At 1400-1500 deg. C, apart from a tendency for grain growth, it was found that the bubbles coalesce to a considerable degree, with accompanying start of porosity interconnection and formation of tunnels at grain edges. In cases where power transients were applied, this interconnection phenomenon is particularly marked in areas having reached 1300 deg. C in the plateau phase. The metallic precipitates associated with the bubbles were analysed by the EDS SEM system. Three classes of precipitates were distinguished, with a typical composition being given for each of them. These results must be supplemented by ceramographs and TEM examination. (author). 11 refs, 4 figs, 3 tabs.

26147 (IAEA-TECDOC–697, pp. 176-182) **FGR model improvement for high burnup fuel analysis.** Mori, K. (Nuclear Fuel Industries Ltd, Osaka (Japan)); Ikeda, H.; Furuya, N. International Atomic Energy Agency, Vienna (Austria). Apr 1993. (CONF-9204252–: Technical committee meeting on fission gas release and fuel rod chemistry related to extended burnup, Pembroke (Canada), 28 Apr - 1 may 1992). In *Fission gas release and fuel rod chemistry related to extended burnup: Proceedings of a technical committee meeting held in Pembroke, Ontario, Canada, 28 April - 1 May 1992.* [235p.] Order Number DE93628297. Source: OSTI; NTIS (US Sales Only); INIS.

NFI has developed and has been utilizing FPAC code (Fuel Performance Analysis Code) to analyze fuel behavior. Two main models in FPAC were revised in 1988 to expand the capability of the code based on the available high burnup fuel data at that time. Fission gas release from pellets (FGR) is modelled in FPAC based on diffusion theory. Diffusion constant in the model consists of three terms: K1, K2 and K3. K1 models the gas channels through grain boundaries and was revised to be more sensitive to fuel temperature. K2 models FGR enhancement by burnup increase and was adjusted to be less sensitive to burnup. K3 models the gas channels through open porosities. As a total, these constants were adjusted to minimize the error of code prediction. A new pellet relocation model was introduced into the code to predict the fuel temperature and clad deformation accurately. FGR is sensitive to fuel temperature and the code prediction is closely related to these models. 7 refs, 8 figs, 3 tabs.

26148 (IAEA-TECDOC–697, pp. 205-211) **Evaluation of measured high burnup fuel temperature at Riso project phase 3.** Kitajima, S. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)); Kinoshita, M. International Atomic Energy Agency, Vienna (Austria). Apr 1993. (CONF-9204252–: Technical committee meeting on fission gas release and fuel rod chemistry related to extended burnup, Pembroke (Canada), 28 Apr - 1 may 1992). In *Fission gas release and fuel rod chemistry related to extended burnup: Proceedings of a technical committee meeting held in Pembroke, Ontario, Canada, 28 April - 1 May 1992.* [235p.] Order Number DE93628297. Source: OSTI; NTIS (US Sales Only); INIS.

We developed an effective thermal conductivity model of pellet which includes effects of open spaces in pellet and fission product solid solution. At Riso project phase 3, measured fuel central temperature indicated that the effective thermal conductivity of pellet decreased as burnup increased. This project also examined the relation of filled gas component and fuel temperature. We evaluated

Riso data utilizing the fuel performance evaluation code involving the model, and found out that the effective thermal conductivity of pellet decreased about 25% at 40 MWd/kgUO2. The code could simulate the observed temperature drop of Xenon filled rod after fission gas burst release at Riso project. And the analyses of the Riso data show that contribution of the open spaces for the thermal conductivity degradation is more than 30% of the total degradation. (author). 8 refs, 11 figs, 1 tab.

26149 (IAEA-TECDOC–697, pp. 211-218) **A simple fission gas release/gaseous swelling model.** Kogai, T. (Nippon Nuclear Fuel Development Co. Ltd., Oarai, Ibaraki (Japan)). International Atomic Energy Agency, Vienna (Austria). Apr 1993. (CONF-9204252–: Technical committee meeting on fission gas release and fuel rod chemistry related to extended burnup, Pembroke (Canada), 28 Apr - 1 may 1992). In *Fission gas release and fuel rod chemistry related to extended burnup: Proceedings of a technical committee meeting held in Pembroke, Ontario, Canada, 28 April - 1 May 1992.* [235p.] Order Number DE93628297. Source: OSTI; NTIS (US Sales Only); INIS.

A model was developed to evaluate fission gas release and gaseous swelling of LWR fuels. The model described gas atom behavior via transport of gas atoms from in-grain to grain boundary sites, formation of intergranular gas bubbles, and release of gas atoms to the rod free volume. The release considered of two competing mechanisms, i.e bubble growth and pellet microcracking. The microcracking used tensile stress in a pellet fragment as its index. Agreement, which validated the overall model formulation, was obtained between the calculated and measured fission gas releases. The abrupt gas release observed at power reduction was simulated by the microcracking model. Comparison of the gas atom retention distribution showed that the model currently responded to the temperature rise and simulated the EPMA measured profile satisfactorily. (author). 8 refs, 4 figs, 1 photo.

26150 (IAEA-TECDOC–697, pp. 219-224) **An approach to modelling fuel behaviour using data from some international high burnup fuel programmes.** Nordstroem, L.A. (Paul Scherrer Inst. (PSI), Villigen (Switzerland)); Ott, C. International Atomic Energy Agency, Vienna (Austria). Apr 1993. (CONF-9204252–: Technical committee meeting on fission gas release and fuel rod chemistry related to extended burnup, Pembroke (Canada), 28 Apr - 1 may 1992). In *Fission gas release and fuel rod chemistry related to extended burnup: Proceedings of a technical committee meeting held in Pembroke, Ontario, Canada, 28 April - 1 May 1992.* [235p.] Order Number DE93628297. Source: OSTI; NTIS (US Sales Only); INIS.

The well-defined fuel rod tests from the international research programmes TRIBULATION and High Burnup Effects Programme have provided a large amount of fuel performance data for computer code verification and validation. This report describes the calculation approach used to simulate the fuel rod deformations and fission gas release focused on some rods irradiated to high burnups. The TRANSURANUS computer code was used for the calculations. In a first phase the fuel densification input parameter as well as the fuel swelling and clad creep-down rates have been adjusted in order to reproduce the measured end-of-life clad dimensional changes. The agreement was very good. The experimental fission gas releases were then compared with the values predicted by three different models. Besides the standard model URGAS also the Halden model as well as the one from Framatome were implemented in TRANSURANUS. A significant discrepancy was found not only between the different models but also between the measured fission gas release values. The achieved result was discussed and some conclusions from this first step on the way to develop a new model at PSI to be used with TRANSURANUS were drawn. (author). 11 refs, 4 figs.

26151 (IAEA-TECDOC–697, pp. 225-230) **Fuel performance modeling of high burnup fuel.** Shann, S.H. (Siemens Nuclear Power Corp., Richland, WA (United States)); Swam, L.F. van. International Atomic Energy Agency, Vienna (Austria). Apr 1993. (CONF-9204252–: Technical committee meeting on fission gas release and fuel rod chemistry related to extended burnup, Pembroke (Canada), 28 Apr - 1 may 1992). In *Fission gas release and fuel rod chemistry related to extended burnup: Proceedings of a technical committee meeting held in Pembroke, Ontario, Canada, 28 April - 1 May 1992.* [235p.] Order Number DE93628297. Source: OSTI; NTIS (US Sales Only); INIS.

A Siemens Nuclear Power Corporation (SNP) developed fuel performance code with its diffusion controlled fission gas release model was modified for high burnup application. The modeling changes included a modification of fuel thermal conductivity, addition of the pellet rim effect, and modifications of the fission gas release model. With the data obtained in the High Burnup Effects Program, various aspects of the code were validated: Prediction of retained gas inside fuel grain versus EPMA (electron probe microanalysis) measured Xe data; Prediction of total retained gas (inside grain and in grain boundary) versus XRF (X-ray fluorescence) measured Xe data; Prediction of Pu production versus EPMA measured Pu/U data; Prediction of radial burnup distribution versus EPMA measured Nd data. The validation results indicate that the modified code accurately accounts for the fuel pellet rim effect and with a high degree of accuracy predicts the pellet burnup profile, retained fission gas, and fission gas released to the rod free volume up to high burnup. (author). 8 refs, 6 figs, 1 tab.

26152 (IVO-A–11/92) **Loviisa nuclear power plant analyzer.** Porkholm, K. (Imatran Voima Oy, Vantaa (Finland)); Nurmilaukas, P.; Tiihonen, O.; Haenninen, M.; Puska, E. Imatran Voima Oy (IVO), Helsinki (Finland). Dec 1992. [68p.] Order Number DE93629708. Source: OSTI; NTIS; INIS.

The APROS Simulation Environment has been developed since 1986 by Imatran Voima Oy (IVO) and the Technical Research Centre of Finland (VTT). It provides tools, solution algorithms and process components for use in different simulation systems for design, analysis and training purposes. One of its main nuclear applications is the Loviisa Nuclear Power Plant Analyzer (LPA). The Loviisa Plant Analyzer includes all the important plant components both in the primary and in the secondary circuits. In addition, all the main control systems, the protection system and the high voltage electrical systems are included. (orig.).

26153 (JAERI-M–93-032) **Assessment of TRAC-PF1/MOD1 code for core thermal hydraulic behavior during reflood with CCTF and SCTF data.** Akimoto, Hajime (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment); Ohnuki, Akira; Murao, Yoshio; Kikuta, Michitaka. Japan Atomic Energy Research Inst., Tokyo (Japan). Mar 1993. 202p. Order Number DE93508319. Source: OSTI; NTIS; INIS.

Post test calculations for six selected Cylindrical Core Test Facility (CCTF) and Slab Core Test Facility (SCTF) tests were performed to assess the TRAC-PF1 code for core thermal hydraulic behaviors during the reflood in a PWR LOCA. It was found through comparisons of calculated results with measured results that predicted void fraction and core mass with the TRAC-PF1 code showed poor agreement with measured results in quantity and that the TRAC-PF1 code predicted well turnaround time, turnaround temperature and quench time in clad temperature transient including parameter effect of system pressure and core power level. In the calculation for the CCTF best-estimate test, which was performed with low initial clad temperature, the TRAC-PF1 code predicted higher core cooling rate and faster quench propagation than measured results. A study on the interfacial friction model and wall heat transfer model was performed to identify problem areas of the TRAC-PF1 code. It is recommended to improve following models of the TRAC-PF1 code for more realistic prediction of core thermal hydraulic behaviors during the reflood in a PWR LOCA: (1) Interfacial friction model in the bubbly/slug flow regime, (2) Interfacial friction model in the vicinity of the flow transition point from the churn flow to the annular/dispersed flow, (3) Wall heat transfer model in the film boiling regime, and (4) Wall heat transfer model on the criteria for the boiling transition from the film boiling to the transition boiling at low initial clad temperature. (author).

26154 (KTM/E-B–125) **YKAe - Nuclear power plant systems behaviour and operational aspects of safety: Evaluation of research programme 1990-1992.** Hayns, M.R. (AEA Reactor Services, Harwell (United Kingdom)); Wolfert, K.; Sandervaag, O. Ministry of Trade and Industry, Helsinki (Finland). Energy Dept. Dec 1992. [40p.] Order Number DE93629709. Source: OSTI; NTIS; INIS.

Finland's energy research programmes.

The report is a mid term evaluation of the YKAe programme started in 1990. In the area safe margins of nuclear fuel and reactor core the work in support of improved performance of LWR fuel is primarily an economic matter and, therefore, should be funded directly by the utilities. As regards assessment of transient and accident situations the experiments in the PACTEL facility provide conditions for VVER reactors which are not available anywhere else. Every effort should be made to utilize this facility in further international programmes. The analysis methods developed for accident and the fire risk studies are excellent and well focused in the specific needs of the Finnish programmes. Further activities in transient and accident modelling should be coupled with the work of the APROS programme. Studies on the new technology in supervision and control of nuclear power plant processes are of special importance to Finland either for the 5th nuclear power station or for the upgrading existing systems. The work on computerized operator support systems looks to be achieving maturity and should be considered for more downstream funding. The human factors studies are of direct relevance to reactor operations. The human factors research appears sub-critical and deserves more support. Overall, the Evaluation Team felt that this small programme was well focused on Finland's needs, well integrated into the international programmes and provided good value for money. The programme direction and balance is good, and with only minor shift emphasis, should carry on its projected course.

26155 (NUREG/IA–0090) **Assessment of RELAP5/MOD2 using the test data of REWET-II reflooding experiment SGI/R.** Haemaelaeinen, A. (Valtion Teknillinen Tutkimuskeskus, Helsinki (Finland). Nuclear Engineering Lab.). Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Valtion Teknillinen Tutkimuskeskus, Helsinki (Finland). Nuclear Engineering Lab. May 1993. 32p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Source: OSTI; NTIS; INIS; GPO.

An analysis of a reflooding experiment with RELAP5/MOD2 cycle 36.04 is presented. The experiment had been carried out in the REWET-II facility simulating the reactor core with a bundle of 19 electrically heated rods. On the basis of the results of two calculations recommendations for the core nodalization are presented, and a modification to the code is proposed.

26156 (NUREG/IA–0100) **Assessment of CCFL model of RELAP5/MOD3 against simple vertical tubes and rod bundle tests: International Agreement Report.** Cho, S. (Korea Electric Power Corp., Taejon (KR). Research Center); Arne, N.; Chung, B.D.; Kim, H.J. Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Korea Electric Power Corp., Taejon (Korea, Republic of). Research Center; Korea Inst. of Nuclear Safety, Taejon (Korea, Republic of). Jun 1993. 114p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Source: OSTI; NTIS; INIS; GPO.

Prepared as part of The Agreement on Research Participation and Technical Exchange under the International Thermal-Hydraulic Code Assessment and Application Program (ICAP).

The CCFL model used in RELAP5/MOD3 version 5m5 has been assessed against simple vertical tubes and bundle tests performed at a facility of Korea Atomic Energy Research Institute. The effect of changes in tube diameter and nodalization of tube section were investigated. The roles of interfacial drags on the flooding characteristics are discussed. Differences between the calculation and the experiment are also discussed. A comparison between model assessment results and the test data showed that the calculated value lay well on the experimental flooding curve specified by user, but the pressure jump before onset of flooding was not calculated.

26157 (NUREG/IA–0106) **Assessment of PWR Steam Generator modelling in RELAP5/MOD2: International Agreement Report.** Putney, J.M. (National Power, Leatherhead (GB). Technology and Environment Centre); Preece, R.J. Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; National Power, Leatherhead (United Kingdom). Technology and Environment Centre. Jun 1993. 112p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). (TEC/L–0471/R91). Source: OSTI; NTIS; INIS; GPO.

Prepared as part of The Agreement on Research Participation and Technical Exchange under the International Thermal-Hydraulic Code Assessment and Application Program (ICAP).

An assessment of Steam Generator (SG) modelling in the PWR thermal-hydraulic code RELAP5/MOD2 is presented. The assessment is based on a review of code assessment calculations performed in the UK and elsewhere, detailed calculations against a series of commissioning tests carried out on the Wolf Creek PWR and analytical investigations of the phenomena involved in normal and abnormal SG operation. A number of modelling deficiencies are identified and their implications for PWR safety analysis are discussed – including methods for compensating for the deficiencies through changes to the input deck. Consideration is also given as to whether the deficiencies will still be present in the successor code RELAP5/MOD3.

26158 (NUREG/IA–0108) **Assessment of RELAP5/MOD2 against a turbine trip from 100% power in the Vandellos II nuclear power plant.** Llopis, C. (Asociacion Nuclear Vandellos, Barcelona (ES)); Perez, J.; Mendizabal, R. Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Asociacion Nuclear Vandellos, Barcelona (Spain); Consejo de Seguridad Nuclear, Madrid (Spain). Jun 1993. 54p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). (ICSP–V2-R100-R). Source: OSTI; NTIS; INIS; GPO.

An assessment of RELAP5/MOD2 cycle 36.04 against a turbine trip from 100% power in the Vandellos II NPP (Spain) is presented. The work is inscribed in the framework of the Spanish contribution to ICAP Project. The model used in the simulation consists of a single loop, a steam generator and a steam line up to the steam header all of them enlarged on a scale of 3:1; and full-scaled reactor vessel and pressurizer. The results of calculations have been in reasonable agreement with plant measurements. An additional study has been performed to check the ability of a model in which all the plant components are full-scaled to reproduce the transient. A second study has been performed using the Homogeneous Equilibrium Model in the pressurizer, trying to elucidate the influence of the velocity slip in the primary depressurization rate.

26159 (NUREG/IA–0109) **Assessment of RELAP5/MOD2 against a 10% load rejection transient from 75% steady state in the Vandellos II Nuclear Power Plant.** Llopis, C. (Asociacion Nuclear Vandellos, Barcelona (ES)); Casals, A.; Perez, J.; Mendizabal, R. Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Asociacion Nuclear Vandellos, Barcelona (Spain); Consejo de Seguridad Nuclear, Madrid (Spain). May 1993. 53p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). (UNID–91-08). Source: OSTI; INIS; GPO; NTIS (documentation only); ESTSC (complete software package), P.O. Box 1020, Oak Ridge, TN 37831-1020.

The Consejo de Seguridad Nuclear (CSN) and the Asociacion Nuclear Vandellos have developed a model of Vandellos II Nuclear Power Plant. The ANV collaboration consisted in the supply of design and actual data, the cooperation in the simulation of the control systems and other model components, as well as in the results analysis. The obtained model has been assessed against the following transients occurred in plant: A trip from the 100% power level (CSN); A load rejection from 100% to 50% (CSN); A load rejection from 75% to 65% (ANV); A feedwater turbopump trip (ANV). This copy is a report of the load rejection from 75% to 65% transient simulation. This transient was one of the tests carried out in Vandellos II NPP during the startup tests.

26160 (NUREG/IA–0116) **Assessment of RELAP5/MOD3/V5M5 against the UPTF Test No. 11 (countercurrent flow in PWR hot leg).** Curca-Tivig, F. (Siemens AG-KWU Group, Erlangen (DE)). Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Siemens AG Unternehmensbereich KWU, Erlangen (Germany). May 1993. 108p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). (KWU–E412/91/E1002). Source: OSTI; NTIS; INIS; GPO.

Analysis of the UPTF Test No. 11 using the "best-estimate" computer code RELAP5/MOD3/Version 5M5 is presented. Test No. 11 was a quasi-steady state, separate effect test designed to investigate the conditions for countercurrent flow of steam and saturated water in the hot leg of a PWR. Without using the code's new countercurrent flow limitation (CCFL) model, RELAP5/MOD3/V5M5 overestimated the mass flow rate of back down flowing water up to 35% (1.5 MPa runs) and 43% (0.3 MPa runs). This is the most obvious difference to RELAP5/MOD2, which did not allow enough countercurrent flow. From the point of view of performing plant calculations this is certainty an improvement, because the new junction-based CCFL option could be used to restrict the flows to a flooding curve defined by a user-supplied correlation. Very good agreement with the experimental data for 1.5 MPa – which are relevant for SBLOCA reflux condensation conditions – could be obtained using the code's new CCFL option in the middle of the inclined part (riser) of the hot leg. Using the same CCFL correlation for the simulation of 0.3 MPa test series – typical for reflood conditions – the code underestimated by 44% the steam mass flow rate at which complete liquid carry over occurs. An unphysical result was received using a CCFL correlation of the Wallis type with the intercept C = 0.644 and the slope m = 0.8. The unphysical prediction is an indication of possible programming errors in the CCFL model of the RELAP5/MOD3/V5M5 computer code.

26161 (PNL–8451) **Spent nuclear fuel storage – Performance tests and demonstrations.** McKinnon, M.A.; DeLoach, V.A. Pacific Northwest Lab., Richland, WA (United States). Apr 1993. 142p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93012875. Source: OSTI; NTIS; INIS; GPO Dep.

This report summarizes the results of heat transfer and shielding performance tests and demonstrations conducted from 1983 through 1992 by or in cooperation with the US Department of Energy (DOE), Office of Commercial Radioactive Waste Management (OCRWM). The performance tests consisted of 6 to 14 runs involving one or two loadings, usually three backfill environments (helium, nitrogen, and vacuum backfills), and one or two storage system orientations. A description of the test plan, spent fuel load patterns, results from temperature and dose rate measurements, and fuel integrity evaluations are contained within the report.

26162 (YJT–92-22) **Actinides and beta emitters in the process water and ion exchange resin samples from the Loviisa power plant.** Puukko, E. (Helsinki Univ. (Finland). Dept. of Radiochemistry); Jaakkola, T. Nuclear Waste Commission of Finnish Power Companies, Helsinki (Finland). Oct 1992. [63p.] Order Number DE93631504. Source: OSTI; NTIS; INIS.

The process waters and the ion exchange resins used for purification of the process waters of the Loviisa nuclear power plant, where are two VVER-440-type PWR reactors, were analysed for their concentrations of alpha and beta emitters. Co-60, Ni-63, Sr-90, Cs-137, U-234, U-238, Pu-239,240, Am-241, Cm-242 and Cm-243,244 were determined in the primary coolant, the ion exchange resins of the primary circuit and the waste tank TW30B03, which contains all used ion exchange resins. The coolant and ion exchange resin samples from the primary circuit represented the normal operation state and a fuel leakage situation. In addition, the concentrations of Tc-99 and I-129 were determined in the waste tank resins.

2103 Power Reactors, Nonbreeding, Graphite Moderated

Refer also to citation(s) 25705, 26218, 26275, 26276, 26364

26163 (IAE–5008-4) **On implementation of the self-protection principle to the reactors with fast-resonance neutron spectrum.** Kuznetsov, V.V.; Morozov, A.G.; Slesarev, I.S.; Alekseev, P.N.; Zverkov, Yu.A.; Subbotin, S.A. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (Russian Federation). Inst. Atomnoj Ehnergii. 1990. [39p.] Order Number DE93628318. Source: OSTI; NTIS (US Sales Only); INIS.

The calculational substantiation of SWPR posessing inherent physical properties of self-protection against possible accidents is given. A variety of approaches to the layout of these reactors have been found, the possible level of their fuel utilization characteristics is analyzed. 12 refs.; 14 figs.; 6 tabs.

26164 (INIS-GB–488) **Statement of nuclear incidents (1st. Qtr. 1990): Bradwell nuclear power station, Essex (Nuclear Electric).** Health and Safety Executive, London (United Kingdom). Jun 1990. [3p.] Order Number DE93631514. Source: OSTI; NTIS (US Sales Only); INIS.

Only one incident was reported; at Bradwell nuclear power station, where there was a leak of carbon dioxide gas. No radioactive contamination was detected and the amount of gas released was well within operating levels. (UK).

26165 (JAERI-M–92-215) **Proceedings of the 2nd JAERI symposium on HTGR technologies October 21 ≈ 23, 1992, Oarai, Japan.** Japan Atomic Energy Research Inst., Tokyo (Japan). Jan 1993. 726p. (CONF-9210382–: 2. JAERI symposium on HTGR technologies, Oarai (Japan), 21-23 Oct 1992). Order Number DE93508315. Source: OSTI; NTIS; INIS.

The Japan Atomic Energy Research Institute (JAERI) held the 2nd JAERI Symposium on HTGR Technologies on October 21 to 23, 1992, at Oarai Park Hotel at Oarai-machi, Ibaraki-ken, Japan, with support of International Atomic Energy Agency (IAEA), Science and Technology Agency of Japan and the Atomic Energy Society of Japan on the occasion that the construction of the High Temperature Engineering Test Reactor (HTTR), which is the first high temperature gas-cooled reactor (HTGR) in Japan, is now being proceeded smoothly. In this symposium, the worldwide present status of research and development (R and D) of the HTGRs and the future perspectives of the HTGR development were discussed with 47 papers including 3 invited lectures, focusing on the present status of HTGR projects and perspectives of HTGR Development, Safety, Operation Experience, Fuel and Heat Utilization. A panel discussion was also organized on how the HTGRs can contribute to the preservation of global environment. About 280 participants attended the symposium from Japan, Bangladesh, Germany, France, Indonesia, People's Republic of China, Poland, Russia, Switzerland, United Kingdom, United States of America, Venezuela and the IAEA. This paper was edited as the proceedings of the 2nd JAERI Symposium on HTGR Technologies, collecting the 47 papers presented in the oral and poster sessions along with 11 panel exhibitions on the results of research and development associated to the HTTR. (author).

26166 (LU-SCS-RR–91.39) **Decision conferencing and the International Chernobyl Project.** French, S. (Leeds Univ. (United Kingdom). School of Computer Studies); Kelly, N.; Morrey, M. Leeds Univ. (United Kingdom). School of Computer Studies. Dec 1991. [17p.] Order Number DE93628319. Source: OSTI; NTIS (US Sales Only); INIS.

As part of the International Chernobyl Project, five decision conferences were held with the Soviet authorities to identify the major factors driving decision making in relation to relocation and other protective measures which are being applied in the affected regions of Byelorussia, Ukraine and the Russian Federation. This report describes the running of those conferences and the conclusions reached from them. (Author).

26167 (ORNL/FTR–4412) **Testing and surveillance of corrosion for the steam generator (SG) materials of the New Production-Modular High-Temperature Gas-cooled Reactor program: Foreign trip report, August 31–September 5, 1992.** Bell, G.E.C. (Oak Ridge National Lab., TN (United States)); Funk, D.R. Oak Ridge National Lab., TN (United States). 5 Oct 1992. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93011398. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report discusses meetings held between representatives from the NP-MHTGR SG design and testing organizations and NE [formerly Central Electricity Generating Board(CEGB)] to discuss secondary-side corrosion testing programs. Topics included water chemistry specification and control, flow-induced vibration and wear, materials, and corrosion. Discussions with CML were conducted on the technology and sensor design for the use of state-of-the-art electrochemical technology [electrochemical noise

(EN)] for conducting corrosion surveillance in both model boiler and autoclave test programs for the NP-MHTGR. The results of these meetings will significantly increase the quality of the testing programs and reduce the uncertainty and risk associated with the design of the NP-MHTGR SG.

2104 Power Reactors, Nonbreeding, Otherwise Moderated Or Unmoderated

Refer also to citation(s) 25890, 26246, 26262, 26396

26168 (IAEA-TECDOC–697, pp. 53-59) **Fission-gas release in fuel performing to extended burnups in Ontario Hydro nuclear generating stations.** Floyd, M.R. (Ontario Hydro, Chalk River, ON (Canada). Nuclear Operations Central Div.); Novak, J.; Truant, P.T. International Atomic Energy Agency, Vienna (Austria). Apr 1993. (CONF-9204252–: Technical committee meeting on fission gas release and fuel rod chemistry related to extended burnup, Pembroke (Canada), 28 Apr - 1 may 1992). In *Fission gas release and fuel rod chemistry related to extended burnup: Proceedings of a technical committee meeting held in Pembroke, Ontario, Canada, 28 April - 1 May 1992.* [235p.] Order Number DE93628297. Source: OSTI; NTIS (US Sales Only); INIS.

The performance of 37-element fuel at extended burnups is of interest to reactor operators who desire a better understanding of the limits of operation, particularly for fuel resident in fuel channels that cannot be refuelled for an extended period of time. The average discharge burnup of CANDU fuel is about 200 MWh/kgU. A significant number of 37-element bundles have achieved burnups in excess of 400 MWh/kgU. Some of these bundles have experienced failures related to their extended operation. To date, hot-cell examinations have been performed on fuel elements from nine 37-element bundles irradiated in Bruce NGS-A that have burnups in the range of 300-800 MWh/kgU. Most of these have declining power histories from peak powers of up to 59 kW/m. Fission-gas release of up to 26% have been observed and exhibit a strong dependence on fuel power. This obscures any dependence on burnup. The extent of fission-gas release at extended burnups was not predicted by low-burnup code extrapolations. This is attributed primarily to a reduction in fuel thermal conductivity which results in elevated operating temperatures. Reduced conductivity is due, at least in part, to the buildup of fission products in the fuel matrix. Some evidence of hyperstoichiometry exists, although this needs to be further investigated along with any possible relation to CANLUB graphite coating behaviour and sheath oxidation. Residual tensile sheath strains of up to 2% have been observed and can be correlated with fuel power/fission-gas release. SCC-related defects have been observed in the sheath and endcaps of elements from bundles experiencing declining power histories to burnups in excess of 500 MWh/kgU. This indicates that the current recommended burnup limit of 450 MWh/kgU is justified. SCC-related defects have also been observed in ramped bundles having burnups <450 MWh/kgU. Hence, additional guidelines are in place for power ramping extended-burnup fuel. (author). 6 refs, 9 figs, 1 tab.

26169 (IAEA-TECDOC–697, pp. 153-164) **Fission-product release kinetics from CANDU and LWR fuel during high-temperature steam oxidation experiments.** Cox, D.S. (Atomic Energy of Canada Ltd., Chalk River, ON (Canada). Chalk River Nuclear Labs.); Liu, Z.; Elder, P.H.; Hunt, C.E.L.; Arimescu, V.I. International Atomic Energy Agency, Vienna (Austria). Apr 1993. (CONF-9204252–: Technical committee meeting on fission gas release and fuel rod chemistry related to extended burnup, Pembroke (Canada), 28 Apr - 1 may 1992). In *Fission gas release and fuel rod chemistry related to extended burnup: Proceedings of a technical committee meeting held in Pembroke, Ontario, Canada, 28 April - 1 May 1992.* [235p.] Order Number DE93628297. Source: OSTI; NTIS (US Sales Only); INIS.

The kinetics of Cs and Kr releases from high-burnup CANDU and LWR fuel were measured in hot-cell annealing experiments (HCE-2 series) under simulated severe accident conditions. The Zircaloy-clad specimens were heated in an inert environment and then exposed to flowing steam or air at atmospheric pressure between 1350 and 1650 deg. C. A simultaneous measurement of the oxidation rate of the fuel was made during these experiments. Both the CANDU and LWR fuels showed the same qualitative release behaviour. The Kr release kinetics could be divided into four different stages. During heating in inert conditions, a burst-release of Kr was detected starting at 1200 to 1400 deg. C. The initiating temperature and the quantity of gas released in this stage was found to depend on the irradiation history. The second stage occurred only in fuel heated above 1400 deg. C and could also be characterized as a burst-type release, although the peak rate and total quantity released in this stage increased with annealing temperature. A third peak of gas release occurred upon changing to an oxidizing environment. This peak was produced by a temperature escalation in the fuel resulting from exothermal oxidation of the Zircaloy. A final large gas release occurred after most of the Zircaloy cladding was oxidized, and presumably oxidation of the UO_2 was occurring. The kinetics of Cs release were similar to Kr except for lower Cs releases in the first stage, and a delay of several hundred to several thousand seconds relative to Kr, most notably in the first and fourth release stages. Differences and similarities between the CANDU and LWR results are discussed, and some of the HCE-2 data are compared to results from similar experiments conducted at the Oak Ridge National Laboratory. (author). 18 refs, 16 figs, 2 tabs.

26170 (IAEA-TECDOC–697, pp. 165-172) **Thermal conductivity and gas release from SIMFUEL.** Lucuta, P.G. (Atomic Energy of Canada Ltd., Chalk River, ON (Canada). Chalk River Nuclear Labs.); Verrall, R.A.; Hastings, I.J.; Matzke, H. International Atomic Energy Agency, Vienna (Austria). Apr 1993. (CONF-9204252–: Technical committee meeting on fission gas release and fuel rod chemistry related to extended burnup, Pembroke (Canada), 28 Apr - 1 may 1992). In *Fission gas release and fuel rod chemistry related to extended burnup: Proceedings of a technical committee meeting held in Pembroke, Ontario, Canada, 28 April - 1 May 1992.* [235p.] Order Number DE93628297. Source: OSTI; NTIS (US Sales Only); INIS.

SIMFUEL - SIMulated high-burnup UO_2 FUEL - replicates the chemical state and microstructure of irradiated fuel. Non-radioactive elements in amounts equivalent to given burnup compositions are added to UO_2 powder. Thermal properties of UO_2 at high temperature are among the most important parameters in assessing fuel behaviour at high burnup. Changes in thermal conductivity occur in the fuel during irradiation as fission gas bubbles form and solid fission products (dissolved and precipitated) build up. The thermal diffusivity and specific heat of SIMFUEL were measured between 25 and 1500 deg. C, at two laboratories using two different techniques, with good agreement. These data were combined to obtain thermal conductivity. The conductivity of 3 and 8 at% burnup SIMFUEL was lower than for "pure" UO_2 by 29 and 45% at room temperature, and by 6 and 15% at 1500 deg. C. The decrease in thermal conductivity was approximately linear with burnup. An increase in central fuel temperature of about 200 deg. C was roughly estimated from the change in thermal conductivity reduction of 3 at% burnup SIMFUEL for a linear power of 45 kW/m, assuming no influence from gas bubbles. Isochronal and isothermal release of ion-implanted krypton from UO_2 and SIMFUEL specimens were measured under reducing conditions for gas concentrations which led to temporary trapping of the gas due to gas-defect interactions. Results for these conditions showed somewhat higher release rates from SIMFUEL. For example, at 1400 deg. C the release data from UO_2 and 8 at% burnup SIMFUEL corresponded to an increase by a factor of 7 in the effective diffusion coefficient. For comparison, the increase of 200 deg. C, in central temperature 1500 deg. C, would lead to a 3 times larger change in the diffusion coefficient. 27 refs, 7 figs, 1 tab.

26171 (IAEA-TECDOC–697, pp. 193-201) **Improvement of ELESIM CANDU fuel performance analysis code: Fission product gas release, fuel densification and neutron flux depression.** Suk, H.C. (Korea Atomic Energy Research Inst., Daeduk (Korea, Republic of)); Hwang, W.; Kim, B.G.; Kim, K.S.; Heo, Y.H. International Atomic Energy Agency, Vienna (Austria). Apr 1993. (CONF-9204252–: Technical committee meeting on fission gas release and fuel rod chemistry related to extended burnup, Pembroke (Canada), 28 Apr - 1 may 1992). In *Fission gas release and fuel rod chemistry related to extended burnup: Proceedings of a technical committee meeting held in Pembroke, Ontario, Canada,*

28 April - 1 May 1992. [235p.] Order Number DE93628297. Source: OSTI; NTIS (US Sales Only); INIS.

KAERI has developed two major models which are a comprehensive fission gas release model and a mechanistic fuel densification model, and has expanded the ELESIM database of neutron flux depression in fuel. Based on MATPRO-Version 11(Rev.2), it has also updated the material properties such as fuel thermal conductivity, clad elastic moduli and clad thermal expansion used in ELESIM code of which most material properties are originated from MATPRO-Version 9. Using the KAERI developed models, the expanded database, and the updated material properties, KAERI has improved the ELESIM Computer Code and then the improved version of ELESIM has been designated as KAFEPA(KAERI/AECL Fuel Element Performance Analysis). The KAFEPA code was verified through comparison with fission gas release experimental data taken from AECL and KAERI irradiation tests. (author). 25 refs, 6 figs, 1 tab.

26172 (IAEA-TECDOC–697, pp. 183-193) **Modeling CANDU-type fuel behaviour during extended burnup irradiations using a revised version of the ELESIM code.** Arimescu, V.I. (Atomic Energy of Canada Ltd., Chalk River, ON (Canada). Chalk River Nuclear Labs.); Richmond, W.R. International Atomic Energy Agency, Vienna (Austria). Apr 1993. (CONF-9204252–: Technical committee meeting on fission gas release and fuel rod chemistry related to extended burnup, Pembroke (Canada), 28 Apr - 1 may 1992). In *Fission gas release and fuel rod chemistry related to extended burnup: Proceedings of a technical committee meeting held in Pembroke, Ontario, Canada, 28 April - 1 May 1992.* [235p.] Order Number DE93628297. Source: OSTI; NTIS (US Sales Only); INIS.

High burnup database for CANDU fuel includes several cases from both power station and experimental reactor irradiations, with burnups of up to 800 MW.h/kgU. Power history for each of these cases is different, encompassing low steady-state, declining, and power-ramps. This variety offers a good opportunity to check the models of fuel behaviour, and to identify areas for improvement. Main parameters for comparing calculated versus measured data are fission gas release and sheath hoop strain. Good agreement of the two calculated parameters with experimental data indicates that the global behaviour of the fuel element is adequately simulated by our codes. The ELESIM computer code was used as the simulation tool. Models for fission gas release, swelling and fuel pellet expansion were thoroughly analysed. Changes were proposed for both models. Fuel pellet expansion model was modified to account for gaseous swelling, which becomes important at high burnups. Mathematics of the fission gas release model was upgraded for diffusional release of fission gas atoms to the grain boundaries. A revised version of the ELESIM computer code was used to simulate the cases from the high burnup database. Satisfactory agreement was found for most cases. Discrepancies are discussed in view of alternative mechanisms that can operate and be enhanced at high burnup. These include stoichiometry changes with burnup that affects fission gas release, and also outer pellet rim fission gas release by a grain boundary diffusion process. Main conclusion of this study is that the revised version of the ELESIM code is able to simulate with reasonable accuracy high burnup as well as low burnup CANDU fuel. This includes irradiations of steady-state, declining, or ramped fuel power histories with a prolonged hold at high power. However, future improvements to ELESIM are needed to model fuel power histories with short dwell times at a high terminal ramp power. (author). 19 refs, 11 figs.

26173 (IAEA/UNDP–ROM/87/002-03) **Nuclear safety. Romania. Defective fuel performance evaluation: Technical report. Report prepared for the Government of Romania.** Lewis, B.J. (Royal Military Coll. of Canada, Kingston, ON (Canada). Dept. of Chemistry and Chemical Engineering). International Atomic Energy Agency, Vienna (Austria); United Nations Development Programme. 1992. [29p.] Project ROM/87/002;ROM/9/004. Order Number DE93631520. Source: OSTI; NTIS (US Sales Only); INIS.

This report summarizes the results of a Technical Co-operation mission to Romania (ROM/9/004) to provide an understanding of defective fuel performance on behalf of the International Atomic Energy Agency (IAEA). 34 refs, 3 figs, 1 tab.

26174 (INIS-mf–12758, pp. 25-32) **Implementation of the Embalse nuclear power plant's commissioning.** Joseph, M.A. (Investigacion Aplicada SE (INVAP), San Carlos de Bariloche (Argentina)); Duarte, J.C.; Sainz, R.A. Asociacion Argentina de Tecnologia Nuclear, Buenos Aires (Argentina). 1987. [735p.] (In Spanish). (CONF-8711355–: 15. scientific meeting and 4th Latin American meeting and 1st sessions on nuclear power plants, San Carlos de Bariloche (Argentina), 2-6 Nov 1987). In *Proceedings of the fifteenth scientific meeting; fourth Latin American meeting; first sessions on nuclear power plants start-up.* Order Number DE91003052. Source: OSTI; NTIS (US Sales Only); INIS.

This work points out the main experiences gathered during the Embalse nuclear power plant start-up, which after the first years of operation arise as quite convenient to be taken into account for future nuclear power plants' start-up. (Author).

26175 (INIS-mf–12758, pp. 39-56) **Explosive and corrosive concentration analysis of gases produced in a CANDU type (N_2, D_2, O_2, H_2) nuclear power plant.** Binetti, E.O. (Investigacion Aplicada SE (INVAP), San Carlos de Bariloche (Argentina)). Asociacion Argentina de Tecnologia Nuclear, Buenos Aires (Argentina). 1987. [735p.] (In Spanish). (CONF-8711355–: 15. scientific meeting and 4th Latin American meeting and 1st sessions on nuclear power plants, San Carlos de Bariloche (Argentina), 2-6 Nov 1987). In *Proceedings of the fifteenth scientific meeting; fourth Latin American meeting; first sessions on nuclear power plants.* Order Number DE91003052. Source: OSTI; NTIS (US Sales Only); INIS.

The primary loop gas of an automatic control system of a nuclear power plant is of great importance as regards conservation and safety of the plant. These gases are produced by dissociation due to radiation effects on heavy water. The system is based on a sample capture equipment, a chromatographic analyzer with its associated electronics, a sample separator and conditioner, a temperature and pressure control system of the transport gas, all included in the reactor building, apart from other supporting instrumentation. (Author).

26176 (INIS-mf–12758, pp. 93-108) **Atucha I nuclear power plant transients analysis.** Castano, J. (Empresa Nuclear Argentina de Centrales Electricas SA (ENACE), Buenos Aires (Argentina)); Schivo, M. Asociacion Argentina de Tecnologia Nuclear, Buenos Aires (Argentina). 1987. [735p.] (In Spanish). (CONF-8711355–: 15. scientific meeting and 4th Latin American meeting and 1st sessions on nuclear power plants, San Carlos de Bariloche (Argentina), 2-6 Nov 1987). In *Proceedings of the fifteenth scientific meeting; fourth Latin American meeting; first sessions on nuclear power plants.* Order Number DE91003052. Source: OSTI; NTIS (US Sales Only); INIS.

A program for the transients simulation thermohydraulic calculation without loss of coolant (KWU-ENACE development) to evaluate Atucha I nuclear power plant behaviour is used. The program includes systems simulation and nuclear power plants control bonds with real parameters. The calculation results show a good agreement with the output 'protocol' of various transients of the nuclear power plant, keeping the error, in general, lesser than ± 10% from the variation of the nuclear power plant's state variables. (Author).

26177 (INIS-mf–12758, pp. 182-192) **Materials qualification for nuclear power plants.** Braconi, F. (Empresa Nuclear Argentina de Centrales Electricas SA (ENACE), Buenos Aires (Argentina)). Asociacion Argentina de Tecnologia Nuclear, Buenos Aires (Argentina). 1987. [735p.] (In Spanish). (CONF-8711355–: 15. scientific meeting and 4th Latin American meeting and 1st sessions on nuclear power plants, San Carlos de Bariloche (Argentina), 2-6 Nov 1987). In *Proceedings of the fifteenth scientific meeting; fourth Latin American meeting; first sessions on nuclear power plants.* Order Number DE91003052. Source: OSTI; NTIS (US Sales Only); INIS.

The supply of materials to be used in the fabrication of components submitted to pressure destined to Atucha II nuclear power plant must fulfill the quality assurance requirements in accordance with the international standards. With the aim of promoting the national participation in CNA II, ENACE had the need to adapt these requirements to the national industry conditions and to the availability of official entities' qualification and inspection. As a uniform and normalized assessment for the qualification of materials did

not exist in the country, ENACE had to develop a materials suppliers qualification system. This paper presents a suppliers qualification procedure, its application limits and the alternative procedures for the acceptance of individual stock and for the stock materials purchase. (Author).

26178 (INIS-mf–12758, pp. 125-132) **35% of fracture in one of the Embalse nuclear power plant's entrance collectors.** Galia, A.V. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina). Gerencia de Ingenieria); Marinucci, L.N.M. Asociacion Argentina de Tecnologia Nuclear, Buenos Aires (Argentina). 1987. [735p.] (In Spanish). (CONF-8711355–: 15. scientific meeting and 4th Latin American meeting and 1st sessions on nuclear power plants, San Carlos de Bariloche (Argentina), 2-6 Nov 1987). In *Proceedings of the fifteenth scientific meeting; fourth Latin American meeting; first sessions on nuclear power plants.* Order Number DE91003052. Source: OSTI; NTIS (US Sales Only); INIS.

The purpose of this work is to simulate an accident of a 35% of fracture at the reactor's entrance collector with the FIREBIRD III code, Mod. 1.0, in order to compare the results obtained with those stated in the Safety Report, and besides, to verify the capacity to foresee the steam generator's secondary boundary behaviour on the basis of the actually available models. For this type of fractures, it is expected that this does not basically affect the Heat Transport Primary Loop behaviour since the main heat drain is the fracture. (Author).

26179 (INIS-mf–12758, pp. 133-137) **Loss of energy IV class at 100% of plain power (PP). FIREBIRD III contrast with the mentioned event at 88% of PP occurred at CNE (Embalse nuclear power plant) on February, 23rd., 1984.** Gersberg, S. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina). Gerencia de Ingenieria); Meneghelli, O.; Raviola, F.J.B. de; Lorenzetti, J.R. Asociacion Argentina de Tecnologia Nuclear, Buenos Aires (Argentina). 1987. [735p.] (In Spanish). (CONF-8711355–: 15. scientific meeting and 4th Latin American meeting and 1st sessions on nuclear power plants, San Carlos de Bariloche (Argentina), 2-6 Nov 1987). In *Proceedings of the fifteenth scientific meeting; fourth Latin American meeting; first sessions on nuclear power plants.* Order Number DE91003052. Source: OSTI; NTIS (US Sales Only); INIS.

The work consists of two objectives: (a) to simulate with the FIREBIRD III code an electrical energy loss of the IV class at 100% of plain power (PP); (b) contrast of the mentioned event of type IV loss when the plant operated at 88% of PP. In the case of 100% of PP, three kinds of calculation are made: (a) one of them oriented to the reactor's safety concept, that is, where the slower cut system acts; (2) oriented to analyze the STEPBACK effectiveness; (3) the control systems and cut systems act when the corresponding 'set points' are reached. The results compared with those obtained by the Hydna-3 code and other Canadian references, are satisfactory. In the case of 88%, the Embalse nuclear power plant's supplied information each 12 seconds in the TRIP LOG reactor, and each 1 second in the computer list, the necessary data for the simulation are not available. The transient, varying the parameters, delayed in trip and stepback, and the different cut times of feed water to the secondary loop, are analyzed. (Author).

26180 (INIS-mf–12758, pp. 144-148) **Atucha II nuclear power plant digital simulation.** Santome, D. (Investigacion Aplicada SE (INVAP), San Carlos de Bariloche (Argentina)); Rovere, L.A.T. Asociacion Argentina de Tecnologia Nuclear, Buenos Aires (Argentina). 1987. [735p.] (In Spanish). (CONF-8711355–: 15. scientific meeting and 4th Latin American meeting and 1st sessions on nuclear power plants, San Carlos de Bariloche (Argentina), 2-6 Nov 1987). In *Proceedings of the fifteenth scientific meeting; fourth Latin American meeting; first sessions on nuclear power plants.* Order Number DE91003052. Source: OSTI; NTIS (US Sales Only); INIS.

This paper describes the start-up of a digital simulation code apt to be performed in real time of Atucha II nuclear power plant, foreseeing its subsequent usage in a Basic Principles Simulator. Adaptability and modification of existing routines and development of modules in order to incorporate the necessary variables dynamics to couple the different modes, were the main tasks. The mathematical model used allows the representation of the following sub-systems: (a) a reactor's core point model, which comprehends the neutronic kinetics, fission and decaying powers, thermal transfer and Xe-poisoning calculation; (b) pressurizer, which considers two sub-systems that may or may not be in thermodynamic equilibrium, both in two phases; (c) coolants and moderators bonds considering separate moderator loops with the aim of introducing asymmetric perturbations; (d) secondary sub-subsystem, which includes the feed water loop, pumps, steam generators and control valves; (e) steam generators; (f) control and safety systems, including power control, steam generators levels, moderator's temperature primary loop system, limitations and protection. (Author).

26181 (INIS-mf–12758, pp. 154-159) **Vibrations measurement at the Embalse nuclear power plant's electrical generator.** Salomoni, R.C. (Comision Nacional de Energia Atomica, Embalse (Argentina). Central Nuclear en Embalse); Belinco, C.G.; Pastorini, A.J.; Sacchi, M.A. Asociacion Argentina de Tecnologia Nuclear, Buenos Aires (Argentina). 1987. [735p.] (In Spanish). (CONF-8711355–: 15. scientific meeting and 4th Latin American meeting and 1st sessions on nuclear power plants, San Carlos de Bariloche (Argentina), 2-6 Nov 1987). In *Proceedings of the fifteenth scientific meeting; fourth Latin American meeting; first sessions on nuclear power plants.* Order Number DE91003052. Source: OSTI; NTIS (US Sales Only); INIS.

After the modifications made at the Embalse nuclear power plant's electrical generator to reduce its vibration level produced by electromagnetic phenomena, it was necessary to perform measurements at the new levels, under different areas and power conditions. To this purpose, a work was performed jointly with the 'Vibrations Team' of the ANSALDO Company (the generator constructor) and the Hydrodynamic Assays Division under the coordination and supervision of the plant's electrical maintenance responsible. This paper includes the main results obtained and the instrumentation criteria and analysis performed. (Author).

26182 (INIS-mf–12758, pp. 418-425) **Irradiation program of slightly enriched fuel elements at the Atucha I nuclear power plant.** Casario, J.A. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina). Gerencia de Desarrollo); Cesario, R.H.; Perez, R.A.; Sidelnik, J.I. Asociacion Argentina de Tecnologia Nuclear, Buenos Aires (Argentina). 1987. [735p.] (In Spanish). (CONF-8711355–: 15. scientific meeting and 4th Latin American meeting and 1st sessions on nuclear power plants, San Carlos de Bariloche (Argentina), 2-6 Nov 1987). In *Proceedings of the fifteenth scientific meeting; fourth Latin American meeting; first sessions on nuclear power plants.* Order Number DE91003052. Source: OSTI; NTIS (US Sales Only); INIS.

An irradiation program of fuel elements with slightly enriched uranium is implemented, tending to the homogenization of core at Atucha I nuclear power plant. The main benefits of the enrichment program are: (a) to extend the average discharge burnup of fuel elements, reducing the number of elements used to generate the same amount of energy. This implies a smaller annual consumption of elements and consequently the reduction of transport and replacement operations and of the storage pool systems as well as that of radioactive wastes; (b) the saving of uranium and structural materials (Zircaloy and others). In the initial stage of program an homogeneous core enrichment of 0.85% by weight of U-235 is anticipated. The average discharge burnup of fuel elements, as estimated by previous studies, is approximately 11.6 MW d/kg U. The annual consumption of fuel elements is reduced from 396 of natural uranium to 205, with a load factor of 0.85. It is intended to reach the next equilibrium steps with an enrichment of 1.00 and 1.20% in U-235. (Author).

26183 (INIS-mf–12758, pp. 426-431) **Distribution of equilibrium burnup for an homogeneous core with fuel elements of slightly enriched uranium (0.85% U-235) at Atucha I nuclear power plant.** Sidelnik, J.I. (Comision Nacional de Energia Atomica, Atucha (Argentina). Central Nuclear Atucha I); Perez, R.A.; Salom, G.F. Asociacion Argentina de Tecnologia Nuclear, Buenos Aires (Argentina). 1987. [735p.] (In Spanish). (CONF-8711355–: 15. scientific meeting and 4th Latin American meeting and 1st sessions on nuclear power plants, San Carlos de Bariloche (Argentina), 2-6 Nov 1987). In *Proceedings of the fifteenth scientific meeting; fourth Latin American meeting; first sessions on nuclear power plants.*

Order Number DE91003052. Source: OSTI; NTIS (US Sales Only); INIS.

At Atucha I, the present fuel management with natural uranium comprises three burnup areas and one irradiation path, sometimes performing four steps in the reactor core, according to the requirements. The discharge burnup is 6.0 Mw d/kg U for a waste reactivity of 6.5 m k and a heavy water purity of 99.75%. This is a preliminary study to obtain the distribution of equilibrium burnup of an homogeneous core with slightly enriched uranium (0.85% by weight U-235), using the time-averaged method implemented in the code PUMA and a representative model of one third of core and fixed rod position. It was found a strategy of three areas and two paths that agrees with the present limits of channel power and specific power in fuel rod. The discharge burnup obtained is 11.6 Mw d/kg U. This strategy is calculated with the same method and a full core representation model is used to verify the obtained results. (Author).

26184 (INIS-mf–12758, pp. 437-448) **Results of fuel management at Embalse nuclear power plant. Analysis of performance at other plants.** Paz, A.O. de (Comision Nacional de Energia Atomica, Embalse (Argentina). Central Nuclear en Embalse); Moreno, C.A.; Vinez, J.C. Asociacion Argentina de Tecnologia Nuclear, Buenos Aires (Argentina). 1987. [735p.] (In Spanish). (CONF-8711355–: 15. scientific meeting and 4th Latin American meeting and 1st sessions on nuclear power plants, San Carlos de Bariloche (Argentina), 2-6 Nov 1987). In *Proceedings of the fifteenth scientific meeting; fourth Latin American meeting; first sessions on nuclear power plants.* Order Number DE91003052. Source: OSTI; NTIS (US Sales Only); INIS.

The operating experience of fuel management at the Embalse nuclear power plant from new core to the present situation (approximately 937 days at full power) is described. The average core burnup is about 4000 MW d/t U and the monthly averaged discharge burnup about 7800 MW d/t U. The neutron flux distribution is calculated by means of program PUMA-C, which is periodically checked by comparison between calculated and measured values of 102 vanadium detectors. A comparison of the performance of other reactors type CANDU 600 (Point Lepreau, Gentilly 2, Wolsung) from the point of view of fuel strategy is also presented. The data to perform the comparison were obtained by means of the CANDU system of information exchange between users (COG). (Author).

26185 (INIS-mf–12758, pp. 449-454) **Operation of Atucha I nuclear power plant with 25 cooling channels without fuel elements.** Perez, R.A. (Comision Nacional de Energia Atomica, Atucha (Argentina). Central Nuclear Atucha I); Sidelnik, J.I.; Salom, G.F. Asociacion Argentina de Tecnologia Nuclear, Buenos Aires (Argentina). 1987. [735p.] (In Spanish). (CONF-8711355–: 15. scientific meeting and 4th Latin American meeting and 1st sessions on nuclear power plants, San Carlos de Bariloche (Argentina), 2-6 Nov 1987). In *Proceedings of the fifteenth scientific meeting; fourth Latin American meeting; first sessions on nuclear power plants.* Order Number DE91003052. Source: OSTI; NTIS (US Sales Only); INIS.

In view of the need of removing the irradiation probes from the reactor of Atucha I nuclear power plant, a study about the consequences of operating with 25 channels without their respective fuel elements was performed. This condition was simulated by means of the code PUMA symmetry I and the consequences were analyzed. From the study resulted a program of stepped power reduction of the nuclear plant that would take place during the process of channel emptying. (Author).

26186 (INIS-mf–12758, pp. 455-460) **National supply of reactivity control rods for Embalse nuclear power plant (CNE).** Biondo, C.D. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina). Gerencia de Ingenieria); Carloni, J.G.; Aba, J.A.; Ruggeri, I.; Arakelian, C.; Rubio, N. Asociacion Argentina de Tecnologia Nuclear, Buenos Aires (Argentina). 1987. [735p.] (In Spanish). (CONF-8711355–: 15. scientific meeting and 4th Latin American meeting and 1st sessions on nuclear power plants, San Carlos de Bariloche (Argentina), 2-6 Nov 1987). In *Proceedings of the fifteenth scientific meeting; fourth Latin American meeting; first sessions on nuclear power plants.* Order Number DE91003052. Source: OSTI; NTIS (US Sales Only); INIS.

The manufacture and supply on industrial scale of reactivity control rods for CNE (Embalse nuclear power plant) were developed by the National Atomic Energy Commission (CNEA) together with the private industry, as part of a program aimed to the substitution of imported supplies used in the operation of power plants by materials manufactured in Argentina. So far, the control rods were imported from Canada. In this work, the different development stages performed by CNEA and CONUAR S.A. are described, leading to the supply of a set of 21 cobalt rods to be included in a reactor of CNE in order to qualify this component. Among the main activities performed, the following stand out: specifications development, particularly those concerning to cobalt cores, evaluation of design documentation and elaboration of bidding conditions and a plan of manufacture and control. According to the results obtained during the service and the post-irradiation measurements, the design will be reviewed in order to undertake new manufacturing plans. (Author).

26187 (INIS-mf–12758, pp. 432-436) **Economical benefits for the use of slightly enriched fuel elements at the Atucha-I nuclear power plant.** Sidelnik, J.I. (Comision Nacional de Energia Atomica, Atucha (Argentina). Central Nuclear Atucha I); Sosa, M.A. Asociacion Argentina de Tecnologia Nuclear, Buenos Aires (Argentina). 1987. [735p.] (In Spanish). (CONF-8711355–: 15. scientific meeting and 4th Latin American meeting and 1st sessions on nuclear power plants, San Carlos de Bariloche (Argentina), 2-6 Nov 1987). In *Proceedings of the fifteenth scientific meeting; fourth Latin American meeting; first sessions on nuclear power plants.* Order Number DE91003052. Source: OSTI; NTIS (US Sales Only); INIS.

The fuel represents a very important factor in the operative cost of the Atucha I nuclear power plant. This cost is drastically reduced with the use of fuel elements of slightly enriched uranium. The annual saving is analyzed with actual values for fuel elements with an enrichment of 0.85% by weight of U-235. With the reactor core in equilibrium state the annual saving achieved is approximately 7.5-10 u$s. According to the present irradiation plan, the benefit for the transition period is studied. An analysis of the sensitivity to differential increments in factors determining the cost of fuel elements or to changes in manufacturing losses is also performed, calculating its effect on the waste, the storage of irradiated elements and the amount of UO_2 required. (Author).

26188 (INIS-mf–12758, pp. 576-580) **CNE (central nuclear en Embalse): probabilistic safety study. Loss-of-coolant accidents. Analysis through events sequence.** Layral, S.I. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina). Gerencia de Ingenieria). Asociacion Argentina de Tecnologia Nuclear, Buenos Aires (Argentina). 1987. [735p.] (In Spanish). (CONF-8711355–: 15. scientific meeting and 4th Latin American meeting and 1st sessions on nuclear power plants, San Carlos de Bariloche (Argentina), 2-6 Nov 1987). In *Proceedings of the fifteenth scientific meeting; fourth Latin American meeting; first sessions on nuclear power plants.* Order Number DE91003052. Source: OSTI; NTIS (US Sales Only); INIS.

The aim of this study was to perform for the Embalse nuclear power plant, a probabilistic evaluation of loss-of-coolant accidents (LOCA) to identify the risks associated with them and to determine their acceptability in accordance with norms. This study includes all ruptures in the primary system that produce the automatic activation of 'emergency core cooling system'. Three starting events were selected for the probabilistic evaluation: 100% rupture of an input collector; 5% rupture of an input collector; 1.2% rupture of an input collector. At this stage the evaluation is focussed on the identification and quantization of the main failure sequences that follow a LOCA and lead to an uncontrolled reactor state or 'core meltdown'. The most important contribution to the core meltdown due to LOCA is the failure of supplies that are required for the emergency core cooling system. (Author).

26189 (INIS-mf–12758, pp. 581-585) **CNE (Embalse nuclear power plant): probabilistic safety study. Electric power supply. Events sequence.** Figueroa, N. (Comision Nacional de Energia

Atomica, Buenos Aires (Argentina). Gerencia de Ingenieria). Asociacion Argentina de Tecnologia Nuclear, Buenos Aires (Argentina). 1987. [735p.] (In Spanish). (CONF-8711355–: 15. scientific meeting and 4th Latin American meeting and 1st sessions on nuclear power plants, San Carlos de Bariloche (Argentina), 2-6 Nov 1987). In *Proceedings of the fifteenth scientific meeting; fourth Latin American meeting; first sessions on nuclear power plants.* Order Number DE91003052. Source: OSTI; NTIS (US Sales Only); INIS.

The plant response to the occurrence of the starting event 'total loss of electric power supply to class IV and class III' is analyzed. This involves the study of automatical actions of safety and process systems as well as the operator actions. The probabilistic evaluation of starting event frequency is performed through fault-tree techniques. The frequency of occurrence 'loss of electric power supply to class IV (λIV = 0.56/year) and the probability of failure to demand of 'reserve' generating groups (Pd III 6.79 x 10^{-3}) contribute to the mentioned frequency. As soon as the starting event occurs, the reactor power must be reduced to 0%, the fuel must be cooled through the thermo siphon and decay heat has to be removed. The events sequence analysis leads to the conclusion that the non shutting down of the reactor with any of the shutdown systems is 'incredible' (10^{-6}/year). In all cases the fuel is cooled by building the thermo siphon except when a substantial inventory loss exist due to a closure failure of some valve of pressure and inventory control system. The order of magnitude of the failure of decay heat removal through the steam generators is 4 x 10^{-4}. This removal would be assured by the emergency water system. Therefore, the frequency of the sequence of possible core meltdown, when the reactor does not shut down is: $\lambda = 5 \times 10^{-9}$/year and for the failure of heat removal: $\lambda = 2 \times 10^{-6}$/year. (Author).

26190 (INIS-mf–12758, pp. 586-590) **CNE (Embalse nuclear power plant): probabilistic safety study. Loss of service water. Probabilistic evaluation and analysis through events sequence.** Couto, A.J. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina). Gerencia de Ingenieria); Perez, S.S. Asociacion Argentina de Tecnologia Nuclear, Buenos Aires (Argentina). 1987. [735p.] (In Spanish). (CONF-8711355–: 15. scientific meeting and 4th Latin American meeting and 1st sessions on nuclear power plants, San Carlos de Bariloche (Argentina), 2-6 Nov 1987). In *Proceedings of the fifteenth scientific meeting; fourth Latin American meeting; first sessions on nuclear power plants.* Order Number DE91003052. Source: OSTI; NTIS (US Sales Only); INIS.

This work is part of a study on the service water systems of the Embalse nuclear power plant from a safety point of view. The faults of service water systems of high and low pressure that can lead to situations threatening the plant safety were analyzed in a previous report. The event 'total loss of low pressure service water' causes the largest number of such conditions. Such event is an operational incident that can lead to an accident situation due to faults in the required process systems or by omission of a procedure. The annual frequency of the event 'total loss of low pressure service water' is calculated. The main contribution comes from pump failure. The evaluation of the accident sequences shows that the most direct way to the liberation of fission products is the loss of steam generators as heat sink. The contributions to small and large LOCA and electric supply loss are analyzed. The sequence that leads to tritium release through boiling of moderator is also evaluated. (Author).

26191 (INIS-mf–12758, pp. 591-595) **Atucha I nuclear power plant: Probabilistic safety study. Loss-of-coolant accidents.** Perez, S.S. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina). Gerencia de Ingenieria). Asociacion Argentina de Tecnologia Nuclear, Buenos Aires (Argentina). 1987. [735p.] (In Spanish). (CONF-8711355–: 15. scientific meeting and 4th Latin American meeting and 1st sessions on nuclear power plants, San Carlos de Bariloche (Argentina), 2-6 Nov 1987). In *Proceedings of the fifteenth scientific meeting; fourth Latin American meeting; first sessions on nuclear power plants.* Order Number DE91003052. Source: OSTI; NTIS (US Sales Only); INIS.

The plant response to the group of events 'large coolant loss' in order to evaluate the associated risk is analyzed. The event that covers all events of similar sequence due to its evolution features, being also the most demanded, is selected as starting event. The representative event is the 'guillotine type rupture of cold primary branch'. An annual occurrence frequency of 10/year is assumed for this event. The safety systems, when the event occurs, must assure the reactor shutdown and the core cooling, creating a heat sink to remove the decay heat. The annual frequency of core meltdown due to great loss of coolant is obtained multiplying the annual frequency of the starting event by the probability of failure of involved safety systems. By means of failure trees, the following is obtained: (a) probability of failure to demand of the boron injection shutdown system = 4 x 10^{-2}; (b) probability of failure to demand of the high pressure safety injection = 3 x 10^{-3}; (c) probability of emergency cooling system failure = 4.4 x 10^{-2}. Therefore, the three possible sequences of core meltdown have the following frequencies: $\lambda_1 = 4 \times 10^{-6}$/year $\lambda_2 = 3 \times 10^{-7}$/year $\lambda_3 = 4.4 \times 10^{-6}$/year. (Author).

26192 (INIS-mf–12758, pp. 596-600) **CNE (Embalse nuclear power plant): Probabilistic safety study. Loss of steam generators as heat sink. Probabilistic evaluation and analysis through events sequence.** Lapadula, A.M. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina). Gerencia de Ingenieria). Asociacion Argentina de Tecnologia Nuclear, Buenos Aires (Argentina). 1987. [735p.] (In Spanish). (CONF-8711355–: 15. scientific meeting and 4th Latin American meeting and 1st sessions on nuclear power plants, San Carlos de Bariloche (Argentina), 2-6 Nov 1987). In *Proceedings of the fifteenth scientific meeting; fourth Latin American meeting; first sessions on nuclear power plants.* Order Number DE91003052. Source: OSTI; NTIS (US Sales Only); INIS.

The aim of this paper is to analyze and evaluate from a probabilistic point of view the consequences of a set of failure modes that can produce the loss of steam generators as heat sink. This work is part of a probabilistic study about the incidence of the secondary system on the power plant safety. The failure modes or starting events that are of interest in this study were previously identified. When the reactor is operating at full power, they are: (a) guillotine type rupture in drainage lines of steam generators; (b) severe rupture in downstream supply lines of regulating stations; (c) loss of main feeding flow associated with start up failure of auxiliary feeding system. The annual rate of occurrence of those failure modes is determined on the basis of the statistical values obtained from different sources of reliability data, using when necessary the failure-tree technique. The initial plant response, as well as the operator actions tending to create an alternative heat sink are analyzed through events sequence. It is concluded that the secondary system can seriously threaten the plant safety in two situations: loss of main feeding associated with failure of systems that reduce the reactor power and breakage of draining lines associated with omission failure of operator. (Author).

26193 (INIS-mf–12758, pp. 608-614) **Concept and structure of Instrumentation and control of the Atucha II nuclear power plant.** Garzon, D. (Empresa Nuclear Argentina de Centrales Electricas SA (ENACE), Buenos Aires (Argentina)); Roca, J.L. Asociacion Argentina de Tecnologia Nuclear, Buenos Aires (Argentina). 1987. [735p.] (In Spanish). (CONF-8711355–: 15. scientific meeting and 4th Latin American meeting and 1st sessions on nuclear power plants, San Carlos de Bariloche (Argentina), 2-6 Nov 1987). In *Proceedings of the fifteenth scientific meeting; fourth Latin American meeting; first sessions on nuclear power plants.* Order Number DE91003052. Source: OSTI; NTIS (US Sales Only); INIS.

The general structure of instrumentation and control of Atucha II nuclear power plant as well as the technologies used, are described: concepts of functional decentralization and physical centralization; concept of functional group and functional complex; description of the technologies used (physical support) in the project of plant instrumentation and control; description of the different automation levels on the basis of concepts of control interface, automatism, regulation, group and subgroup controls; principles of signal conditioning; concept of announcement of alarms and state: supervisory computer, description of HAS (Hard wired Alarm System) and CAS (Computer Alarm System); application of the above mentioned structure to the project of another type of plants. (Author).

2105 Power Reactors, Breeding

Refer also to citation(s) 25640, 26306, 26332, 26346, 26676, 26699

26194 (ENEA-RT-NUCL–92-09) **ENEA activities on oxide core of PRISM reactor.** Artioli, C.; Cecchini, F.; Dominici, G. ENEA, Bologna (Italy). May 1992. 31p. (CONF-911001–29: International conference on fast reactor systems and fuel cycles, Kyoto (Japan), 27 Oct - 1 nov 1991; RT/NUCL–92-09). Order Number DE93799247. Source: OSTI; NTIS (US Sales Only); INIS.

The main results of ENEA (Italian Agency for Energy, New Technologies and the Environment) research activities, developed in collaboration with the General Electric Company, on oxide core optimization for the PRISM (Power Reactor, Innovative Small Module) advanced liquid metal reactor and on its characterization as an actinide burner are reported.

26195 (EUR–14605) **Codification of LMFBR rules and comparison of codes.** Faure, O. (Societe Franco-Americaine de Constructions Atomiques (FRAMATOME), 92 - Courbevoie (France)); Debaene, J.P. Commission of the European Communities, Luxembourg (Luxembourg). 1993. [75p.] Contract RA1-0138F. Source: OSTI; NTIS (US Sales Only); INIS.

The first part of this report presents the basic RCC-MR (regles de conception et de construction des materiels mecaniques des ilots nucleaires, reacteurs a neutrons rapides) design rules and their purpose. The second part is a qualitative comparison between RCC-MR, Code case N47 (ASME) and ETSDG Guide (MONJU Guide), made on the following topics: negligible creep test, ratcheting, creep fatigue, buckling, piping rules. An outline is given on improvements to RCC-MR rules now in progress.

26196 (FEI–2021) **Some problems of statistical analysis of the empirical data on reactor parameters.** Volkov, Yu.V.; Averin, L.V.; Chistozvonova, E.A.; Shejnkman, A.G. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk (Russian Federation). Fiziko-Ehnergeticheskij Inst. 1989. [11p.] (In Russian). Order Number DE93629726. Source: OSTI; NTIS (US Sales Only); INIS.

The article presents a method of interpreting repetitions in empirical data and a method for validating the assumptions of vacant digit positrons in empiric distribution for charts. The data from BN-600 reactor calculation printonts on margint for cladding maximum temperatures and specific linear loads on fuel elements are presented as an illustration of such applications. The determined peculiarities of empiric distributions of such parameters are explained. 2 refs.; 2 figs.

26197 (FEI–2031) **Evaluation of the boundary resonance effects in fast reactors by the first collision probability method.** Bezborodov, A.A.; Savos'kin, M.M.; Tsibulya, A.M. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk (Russian Federation). Fiziko-Ehnergeticheskij Inst. 1989. [20p.] (In Russian). Order Number DE93629727. Source: OSTI; NTIS (US Sales Only); INIS.

An efficient deterministic approach to the estimation of boundary resonance effects in fast breeder reactors is described, the approach is based on the method of probabilities of first collisions in subgroup representation and implemented in FFPR program. A number of fast breeder systems is investigated. The data are compared with the Monte Carlo method and point to a significant effect of fast boundary regions on criticality of ZPR-111-54 fuel assembly. The investigations of BN-1600 reactor model with heterogeneous core and annular feedstock insertions have revealed small boundary resonance effects and confirm the reliability of forecast of basic functionals derived in serial engineering design. The FF CPR program enables verification of traditional multigroup calculations for various classes of fast breeder reactors. 10 refs.; 6 figs.; 3 tabs.

26198 (FEI–2036) **Test model of high-power fast power reactor in hexagonal geometry: Description and calculational results.** Matveev, V.I.; Bobrov, S.B.; Zinin, A.I.; Ivanov, A.P.; Kolesov, V.E.; Pshakin, G.M.; Seregin, A.S. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk (Russian Federation). Fiziko-Ehnergeticheskij Inst. 1989. [36p.] (In Russian). Order Number DE93629728. Source: OSTI; NTIS (US Sales Only); INIS.

A 3D model of large-power fast breeder power reactor is described in hexagonal geometry. A number of problems is formulated for carrying out test calculations: determination of 'wave-up' enrichments under steady-state refuelling conditions; temperature and power variations; determinations of reactivity effects depending on fuel burnup; determination of control rod efficiency; investigation of energy release field distribution at non-design position of burnup compensators. For the purpose of solving this problems, a 2D model of the reactor is presented in (R,Z) geometry which has been derived from the 3D model through homogenization of certain regions. The results of calculating for this model are presented. The calculations were performed in 2D (R,Z) geometry and in 2D and 3D geometry with hexagonal grid in few-group approximation. 8 refs.; 5 figs.; 18 tabs.

26199 (FEI–2042) **Studying the temperature conditions using a double-circuit model of the fast reactor top chamber.** Opanasenko, A.N.; Romashin, B.A. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk (Russian Federation). Fiziko-Ehnergeticheskij Inst. 1989. [17p.] (In Russian). Order Number DE93629729. Source: OSTI; NTIS (US Sales Only); INIS.

The article presents the results of an experimental investigation of temperature fields using the model of the FBR upper chamber under different operating conditions. Temperature inhomogeneity in the upper chamber depends significant by on the conditions of coolant removal from the leads of fuel assemblies, and the number of operating loops of the secondary circuit. Temperature stratification of liquid occurs along the height of the chamber under transition to natural circulation. 3 refs.; 11 figs.

26200 (INIS-mf–13547, pp. 103-111) **Development and testing of UO_2-Cr dispersing full for fast reactor application.** Trefilov, V.I. (AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst.); Zelenskij, V.F.; Ashikhmin, V.P. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 8.* [232p.] Order Number DE93630368. Source: OSTI; NTIS (US Sales Only); INIS.

Data on creation of oxide dispersing fuel with chromium matrix are presented. Operating conditions of UO_2-Cr micro fuel element production and their consolidation into fuel cores were worked out. Proposed studies of corrosion resistance of cores in wide temperature range in water, vapour, oxygen, nitrogen gave positive results. Fuel tests in fuel elements of nuclear reactors showed reliable efficiency for fuel elements at deplation more than 10% h.a. 5 refs.; 4 figs.; 3 tabs. (author).

26201 (JAERI-M–93-062) **Application of H_∞ optimal estimator to reactivity estimation of fast breeder reactor.** Suzuki, Katsuo (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment); Shimazaki, Junya. Japan Atomic Energy Research Inst., Tokyo (Japan). Mar 1993. 33p. (In Japanese). Order Number DE93508334. Source: OSTI; NTIS; INIS.

In this report a reactivity estimator for a fast breeder reactor is designed using the design method based on H_∞ optimal estimation theory and the estimation results are shown. The H_∞ optimal estimation theory is formulated as a minimax problem where the maximum 'energy' of estimation error over all disturbance trajectories in L_2 functional space is minimized in the sense of H_∞-norm. In the design was used a system model which consists of usual point reactor kinetics equations combined with a state equation of net reactivity driven by fictitious noise/disturbance. Finally, we show by computer simulation that H_∞ estimator gives good results in estimating net reactivity changes caused by various disturbances. (author).

2106 Power Reactors, Mobile, Propulsion, Package, and Transportable

Refer also to citation(s) 25702, 26384

26202 (BNL–48540) **Generation of neutronic thermal data in support of space nuclear propulsion.** Mughabghab, S.; Schmidt, E.; Ludewig, H. Brookhaven National Lab., Upton, NY (United States). [1993]. 8p. Sponsored by USDOE, Washington,

DC (United States). DOE Contract AC02-76CH00016. (CONF-930103–37: 10. symposium on space nuclear power and propulsion, Albuquerque, NM (United States), 10-14 Jan 1993). Order Number DE93013148. Source: OSTI; NTIS; INIS; GPO Dep.

The scattering kernel data for ^{7}LiH have been generated for the first time in the temperature range 50–1000 K. This is based on a phonon distribution function derived from both experimental data and theoretical calculations. A detailed study of the variation of the moderator temperature coefficient $\alpha_m(T)$ with temperature, T, is carried out for a typical space nuclear reactor of the particle bed type. It is established that the moderator temperature coefficient due to chemical binding effects follows the relationship $\alpha_m(T) = C F_v(H)^{1.6}$ where $F_v(H)$ is the volume fraction of bound solid hydrogen and C is a normalization constant which depends on the moderator capture thermal cross section. The value 1.65 is to be compared with 1.54 ± 0.06 derived in a previous study where water scattering kernels are applied. For control and safety reasons, a minimization of this positive component temperature coefficient can be most effective by operating the moderator at high temperatures. Advantages of this approach are outlined. In addition, suggestions are made to render the overall temperature coefficient negative.

26203 (BNL–48562) **A particle bed reactor based NTP in the 112,500 N thrust class.** Ludewig, H.; Powell, J.R.; Lazareth, O.W. Jr.; Todosow, M. Brookhaven National Lab., Upton, NY (United States). [1993]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-930103–32: 10. symposium on space nuclear power and propulsion, Albuquerque, NM (United States), 10-14 Jan 1993). Order Number DE93010936. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This paper discusses the application of a Particle bed Reactor (PBR) to a 112,500 N thrust Nuclear Thermal Propulsion (NTP) Engine. The method of analysis is described, followed by a presentation of the results. It is concluded that the PBR would result in a very competitive NTP engine. In addition, due to the high power densities possible with a PBR, high thrust/weight ratios are possible. This conclusion can be used to satisfy a variety of mission goals.

26204 (BNL–48667) **Nuclear Thermal Propulsion engine based on Particle Bed Reactor using light water steam as a propellant.** Powell, J.R.; Ludewig, H.; Maise, G. Brookhaven National Lab., Upton, NY (United States). [1993]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-930103–40: 10. symposium on space nuclear power and propulsion, Albuquerque, NM (United States), 10-14 Jan 1993). Order Number DE93014336. Source: OSTI; NTIS (US Sales Only); GPO Dep.

In this paper the possibility of configuring a water cooled Nuclear Thermal Propulsion (NTP) rocket, based on a Particle Bed Reactor (PBR) is investigated. This rocket will be used to operate on water obtained from near earth objects. The conclusions reached in this paper indicate that it is possible to configure a PBR based NTP rocket to operate on water and meet the mission requirements envisioned for it. No insurmountable technology issues have been identified.

26205 (BNL–48698) **MCNP benchmark analyses of critical experiments for the Space Nuclear Thermal Propulsion program.** Selcow, E.C. (Brookhaven National Lab., Upton, NY (United States)); Cerbone, R.J.; Ludewig, H.; Mughabghab, S.F.; Schmidt, E.; Todosow, M.; Parma, E.J.; Ball, R.M.; Hoovler, G.S. Brookhaven National Lab., Upton, NY (United States). [1993]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-930103–38: 10. symposium on space nuclear power and propulsion, Albuquerque, NM (United States), 10-14 Jan 1993). Order Number DE93014046. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Benchmark analyses have been performed of Particle Bed Reactor (PBR) critical experiments (CX) using the MCNP radiation transport code. The experiments have been conducted at the Sandia National Laboratory reactor facility in support of the Space Nuclear Thermal Propulsion (SNTP) program. The test reactor is a nineteen element water moderated and reflected thermal system. A series of integral experiments have been carried out to test the capabilities of the radiation transport codes to predict the performance of PBR systems. MCNP was selected as the preferred radiation analysis tool for the benchmark experiments. Comparison between experimental and calculational results indicate very good agreement. This paper describes the analyses of benchmark experiments designed to quantify the accuracy of the MCNP radiation transport code for predicting the performance characteristics of PBR reactors.

26206 (BNL–48700) **Space reactor fuel element testing in upgraded TREAT.** Todosow, M.; Bezler, P.; Ludewig, H.; Kato, W.Y. Brookhaven National Lab., Upton, NY (United States). [1993]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-930103–36: 10. symposium on space nuclear power and propulsion, Albuquerque, NM (United States), 10-14 Jan 1993). Order Number DE93012524. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The testing of candidate fuel elements at prototypic operating conditions with respect to temperature, power density, hydrogen coolant flow rate, etc., a crucial component in the development and qualification of nuclear rocket engines based on the Particle Bed Reactor (PBR), NERVA-derivative, and other concepts. Such testing may be performed at existing reactors, or at new facilities. A scoping study has been performed to assess the feasibility of testing PBR based fuel elements at the TREAT reactor. initial results suggest that full-scale PBR, elements could be tested at an average energy deposition of ~60–80 MW-s/L in the current TREAT reactor. If the TREAT reactor was upgraded to include fuel elements with a higher temperature limit, average energy deposition of ~100 MW/L may be achievable.

26207 (LA-UR–93-1544) **Overview of fuel element development and mass loss rate experiments on uranium–zirconium carbide fuel.** MacMillan, D.P. Los Alamos National Lab., NM (United States). [1993]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930103–34: 10. symposium on space nuclear power and propulsion, Albuquerque, NM (United States), 10-14 Jan 1993). Order Number DE93012735. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The aim of work on the Rover program at the Los Alamos Scientific Laboratory (LASL, now Los Alamos National Laboratory) beginning in 1955 was the development of a nuclear propulsion rocket engine consisting of a core with many holes in it through which hydrogen at high pressure passed and was heated to high temperature for discharge through a nozzle. A number of generations of graphite based fuel elements were developed. Work was initiated in the late 1960s to explore the potential for longer fuel element life and higher temperature operation by basing the fuel structure on (U, Zr) C. The performance of a small number of such fuel elements in the last reactor tested was good enough that it was decided that (U, Zr)C fuel would be used in the next reactor. Manufacture of these elements was well underway when the Rover program was canceled in January of 1973.

26208 (WHC-SA–1420) **Thulium heat sources for space power applications.** Alderman, C.J. Westinghouse Hanford Co., Richland, WA (United States). May 1992. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (CONF-920803–18: Nuclear technologies for space exploration, Jackson, WY (United States), 16-19 Aug 1992). Order Number DE93014145. Source: OSTI; NTIS; INIS; GPO Dep.

Reliable power supplies for use in transportation and remote systems will be an important part of space exploration terrestrial activities. A potential power source is available in the rare earth metal, thulium. Fuel sources can be produced by activating Tm-169 targets in the space station reactor. The resulting Tm-170 heat sources can be used in thermoelectric generators to power instrumentation and telecommunications located at remote sites such as weather stations. As the heat source in a dynamic Sterling or Brayton cycle system, the heat source can provide a lightweight power source for rovers or other terrestrial transportation systems.

26209 (WSRC-TR–92-134) **Data qualification summary for 1985 L-Area AC Flow Tests.** Edwards, T.B.; Eghbali, D.A.; Liebmann, M.L.; Shine, E.P. Westinghouse Savannah River Co., Aiken,

SC (United States). Mar 1992. 124p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93015826. Source: OSTI; NTIS; INIS; GPO Dep.

The 1985 L-Area AC Flow Tests were conducted to provide an extended data base for upgrading the reactor system models employed in predicting normal process water flows. This report summarizes the results of the recently completed, formal, technical review of the data from the 1985 L-Area AC Flow Tests as detailed in document SCS-CMAS-910045. The purpose of that review was to provide corroborating technical information as to the quality (fitness for use) of these experimental data. Reference [1] required three volumes to fully document the results of that Data Qualification process. This report has been prepared to provide the important conclusions from that process in a manageable and understandable format. Consult reference [1] if any additional information or detail is needed. This report provides highlights from that study: an overview of the tests and data, a description of the instrumentation used, an explanation of the data qualification methods employed to review the data, and the important conclusions reached from the study. Reference 1: Edwards, T.B., D.A. Eghbali, M.L. Liebmann, and E.P. Shine, "Data Qualification for 1985 L-Area AC Flow Tests," SCS-CMAS-910045, December 31, 1991.

2107 Regulation and Licensing

Refer also to citation(s) 26277, 26278, 26344, 27658

26210 (INIS-mf–12758, pp. 629-633) **Licensing of nuclear and radioactive installations in Peru.** Medina Gironzini, E. (Instituto Peruano de Energia Nuclear, Lima (Peru)). Asociacion Argentina de Tecnologia Nuclear, Buenos Aires (Argentina). 1987. [735p.] (In Spanish). (CONF-8711355–: 15. scientific meeting and 4th Latin American meeting and 1st sessions on nuclear power plants, San Carlos de Bariloche (Argentina), 2-6 Nov 1987). In *Proceedings of the fifteenth scientific meeting; fourth Latin American meeting; first sessions on nuclear power plants.* Order Number DE91003052. Source: OSTI; NTIS (US Sales Only); INIS.

In Peru, the Regulation for Ionizing Radiation Sources is applied, which establishes the norms and procedures to follow in the nuclear and radioactive installations of the country in order to assure their correct operation as concerns to the nuclear safety and radiological protection, allowing the emission of the respective licenses. As for the nuclear facilities, this authorization includes the Previous License, the Construction License and the Operation License (provisional and definitive) and for radioactive facilities and equipment generating ionizing radiations: the Construction License and the Operation License. The personnel also require a license that can be an operator license (as for nuclear reactors) or a supervisor license (for nuclear and radioactive facilities). In spite of the above mentioned regulation and its long enforcement period, less than 10% of radioactive facilities in this country are licensed, due to different problems which will be solved in the medium term. (Author).

26211 (NUREG–0040-Vol.17-No.1) **Licensee contractor and vendor inspection status report: Quarterly report, January–March 1993: Volume 17, Number 1.** Nuclear Regulatory Commission, Washington, DC (United States). Div. of Reactor Inspection and Licensee Performance. May 1993. 223p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Source: OSTI; NTIS; INIS; GPO.

This periodical covers the results of inspections performed by the NRC's Vendor Inspection Branch that have been distributed to the inspected organizations during the period from January 1993 through March 1993.

26212 (NUREG–0304-Vol.18-No.1) **Regulatory and technical reports (Abstract Index Journal): Compilation for first quarter 1993, January–March: Vol. 18, No. 1.** Nuclear Regulatory Commission, Washington, DC (United States). Div. of Freedom of Information and Publications Services. May 1993. 45p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Source: OSTI; NTIS; INIS; GPO.

This journal includes all formal reports in the NUREG series prepared by the NRC staff and contractors; proceedings of conferences and workshops; as well as international agreement reports. The entries in this compilation are indexed for access by title and abstract, secondary report number, personal author, subject, NRC organization for staff and international agreements, contractor, international organization, and licensed facility.

26213 (NUREG–0386-Digest-6-Rev.6) **United States Nuclear Regulatory Commission Staff practice and procedure digest: Commission, Appeal Board and Licensing Board Decisions, July 1972–June 1992: Digest 6, Revision 6.** Nuclear Regulatory Commission, Washington, DC (United States). Office of the General Counsel. May 1993. 738p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Source: OSTI; NTIS; INIS; GPO.

This 6th revision of the sixth edition of the NRC Practice and Procedure Digest contains a digest of a number of commission, Atomic Safety and Licensing Appeal Board, and Atomic Safety and Licensing Board decisions issued during the period of July 1, 1972 to June 30, 1992, interpreting the NRC's Rules of Practice in 10 CFR Part 2.

26214 (NUREG–0540-Vol.15-No.4) **Title list of documents made publicly available, April 1–30, 1993: Volume 15, No. 4.** Nuclear Regulatory Commission, Washington, DC (United States). Div. of Freedom of Information and Publications Services. Jun 1993. 355p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Source: OSTI; NTIS; INIS; GPO.

This document is a monthly publication containing descriptions of information received and generated by the US Nuclear Regulatory Commission (NRC). This information includes (1) docketed material associated with civilian nuclear power plants and other uses of radioactive materials, and (2) nondocketed material received and generated by NRC pertinent to its role as a regulatory agency. The following indexes are included: Personal Author, Corporate Source, Report Number, and Cross Reference of Enclosures to Principal Documents.

26215 (NUREG–0940-Vol.12-No.1) **Enforcement actions: Significant actions resolved: Quarterly progress report, January–March 1993: Volume 12, No. 1.** Nuclear Regulatory Commission, Washington, DC (United States). Office of Enforcement. Jun 1993. 455p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Source: OSTI; NTIS; INIS; GPO.

This compilation summarizes significant enforcement actions that have been resolved during one quarterly period (January–March 1993) and includes copies of letters, Notices, and Orders sent by the Nuclear Regulatory Commission to licensees with respect to these enforcement actions. It is anticipated that the information in this publication will be widely disseminated to managers and employees engaged in activities licensed by the NRC, so that actions can be taken to improve safety by avoiding future violations similar to those described in this publication.

26216 (NUREG/CR–5955) **Materials and design bases issues in ASME Code Case N-47.** Huddleston, R.L. (Oak Ridge National Lab., TN (United States)); Swindeman, R.W. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Engineering; Oak Ridge National Lab., TN (United States). Apr 1993. 34p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC05-84OR21400. (ORNL/TM–12266). Source: OSTI; NTIS; INIS; GPO.

A preliminary evaluation of the design bases (principally ASME Code Case N-47) was conducted for design and operation of reactors at elevated temperatures where the time-dependent effects of creep, creep-fatigue, and creep ratcheting are significant. Areas where Code rules or regulatory guides may be lacking or inadequate to ensure the operation over the expected life cycles for the next-generation advanced high-temperature reactor systems, with designs to be certified by the US Nuclear Regulatory Commission, have been identified as unresolved issues. Twenty-two unresolved issues were identified and brief scoping plans developed for resolving these issues.

2108 Economics

Refer also to citation(s) 25708, 26119, 26132, 26133, 26187, 26270, 26418

26217 (EUR–14043/6) **Assessment of management alternatives for LWR wastes. Volume 6. Cost determination of the LWR waste management routes (treatment/conditioning/packaging/transport operations).** Thiels, G.M. (Task R and S, Ispra (Italy)); Kowa, S. Commission of the European Communities, Luxembourg (Luxembourg). 1993. [65p.] Contract FI1W/0125-C. Source: OSTI; NTIS (US Sales Only); INIS.

This report deals with the cost determination of a number of schemes for the treatment, conditioning, packaging, interim storage and transport operations of LWR wastes drawn up on the basis of Belgian, French and German practices in this particular area. In addition to the general procedure elaborated for determining, actualizing and scaling of plant and transport costs associated with the various schemes, in-depth calculations of each intermediate management stage are included in this report. This study is part of an overall theoretical exercise aimed at evaluating a selection of management routes for LWR waste based on economical and radiological criteria.

26218 (INIS-GB–481) **Nuclear Electric: the misuse of the subsidy and the case for the immediate closure of Magnox.** Greenpeace, London (United Kingdom). Nov 1992. [9p.] Order Number DE93631647. Source: OSTI; NTIS (US Sales Only); INIS.

The nature and purpose of fossil fuel levy which creates a subsidy for the nuclear industry is discussed. It is claimed that without the subsidy the operation of Magnox and AGR stations generates electricity at a loss. This means that most of the fossil fuel levy is being used to make up Nuclear Electric's losses. The rest is mostly being used to build the Sizewell-B power plant. This is in contrast to the popular belief and understanding that the subsidy is for decommissioning old plants, and cleaning up accumulated spent fuels and other wastes. The economics of the Magnox stations are discussed and Nuclear Electric's claim that closing them would not stop the losses is challenged. (U.K.).

26219 (INIS-mf–13566) **Energy operations policy.** European Bank for Reconstruction and Development, London (United Kingdom). [1993]. [38p.] Order Number DE93631644. Source: OSTI; NTIS (US Sales Only); INIS.

It is reported that energy policy was designed following the European Bank for Reconstruction and Development review of the most pressing energy issues confronting Central and Eastern Europe and the republics of the former Soviet Union. The main features of the policy described in the document set the general framework for the Bank's energy operations. Energy strategies for particular countries are designed as an integral part of the Bank's individual country strategies. Tabs.

26220 (SR/H–540) **[Hanford Department histories]: Accounting Department, Part 2.** [Plant histories]. Hanford Engineer Works, Richland, WA (United States). [1946]. 123p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. Order Number DE93013441. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Stores activities at Hanford have been fundamentally the same as at other du Pont-operated war plants, involving primarily the requisitioning, receiving, warehousing, and dispensing of materials essential to plant operation and maintenance (except basic raw materials). In addition, Stores have been responsible for the shipment of outgoing materials, and the handling of excess materials. These functions have been complicated by the great distances between the various plant areas, and Richland. This document reviews Stores and accounting experience from its inception in December 1943 to July 1, 1945.

22 NUCLEAR REACTOR TECHNOLOGY

2201 Theory and Calculation

Refer also to citation(s) 26117, 26194, 26197, 26205, 26359, 26899, 26900, 28150, 28151

26221 (ANL/NPR–92/17) **DIF3D-K: A nodal kinetics code for solving the time-dependent diffusion equation in hexagonal-Z geometry: New Production Reactors Program.** Taiwo, T.A. Argonne National Lab., IL (United States). Oct 1992. 317p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. Order Number DE93010996. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The development of a three-dimensional, space- and energy-dependent neutron kinetics capability for hexagonal-Z geometry calculations is described. The code employs a nodal method derived using polynomial approximations to the spatial dependence of the flux within each hexagonal prism node for spatial discretization. The resulting time-dependent nodal equations for the neutron flux and precursor concentration moments are solved using one of two major solution methods, the theta method or the space-tune factorization methods (improved quasi-static, adiabatic, or conventional point kinetics). This report describes the derivation of the time-dependent nodal equations, along with the theta method and the space-time factorization methods available for solving them. The report also provides user application and program implementation information. The user information section provides descriptions of the input data, instructions for executing the code, description of the code output, and summary of code limitations. Sample problem input and output are also provided. A description is given of the code structure (code flow and descriptions of code segments), and instructions are provided for implementing the code on Cray-UNICOS computers and UNIX-based workstations. Information is also provided on implementing DIF3D-K as a neutron kinetics module within an integrated dynamics code.

26222 (INIS-mf–12758, pp. 109-119) **Point kinetics improvements to evaluate three-dimensional effects in transients calculation.** Castellotti, U. (Empresa Nuclear Argentina de Centrales Electricas SA (ENACE), Buenos Aires (Argentina)). Asociacion Argentina de Tecnologia Nuclear, Buenos Aires (Argentina). 1987. [735p.] (In Spanish). (CONF-8711355–: 15. scientific meeting and 4th Latin American meeting and 1st sessions on nuclear power plants, San Carlos de Bariloche (Argentina), 2-6 Nov 1987). In *Proceedings of the fifteenth scientific meeting; fourth Latin American meeting; first sessions on nuclear power plants.* Order Number DE91003052. Source: OSTI; NTIS (US Sales Only); INIS.

A calculation method, which considers the flux axial perturbations in the parameters related to the reactivity within a point kinetics model, is described. The method considered uses axial factors of consideration which act on the thermohydraulic variables included in the reactivity calculation. The PUMA three-dimensional code as reference model for the comparisons, is used. The limitations inherent to the reactivity balance of the point models used in the transients calculation, are given. (Author).

26223 (WSRC-TR–91-499) **Verification and validation action matrix summary for AXLIB4.** Le, T.T. Westinghouse Savannah River Co., Aiken, SC (United States). Aug 1991. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93014726. Source: OSTI; NTIS; GPO Dep.

This document identifies the work performed and documentation generated to satisfy action items for the Reactor Physics computer code AXLIB4. Each action item is discussed with the justification for its completion. Specific details of the work performed are not included in this document but are found in references. The validation and verification effort for the AXLIB4 code is completed.

2202 Components and Accessories

Refer also to citation(s) 26091, 26092, 26111, 26177, 26199, 26216, 26265, 26280, 26299, 26315, 26316, 26318, 26321, 26322,

26323, 26324, 26326, 26331, 26345, 26352, 26353, 26365, 26373, 26387, 26397, 26462, 26598, 26608, 26715, 26896, 28038, 28161

26224 (BARC–1992/E/038) **Visco-elastic and visco-plastic analysis of two dimensional structures.** Swami Prasad, P. (Bhabha Atomic Research Centre, Bombay (India). Reactor Design and Development Group); Dutta, B.K.; Kushwaha, H.S.; Kakodkar, A. Bhabha Atomic Research Centre, Bombay (India). 1992. [35p.] Order Number DE93631484. Source: OSTI; NTIS (US Sales Only); INIS.

Finite Element Method has been a very popular numerical technique for the stress analysis of structures. One of the major areas that is being addressed in the last two decades in Finite Element Technique, is nonlinear analysis. The application of nonlinear analysis is increasingly felt in analysing components of nuclear reactors, aerospace structures, metal forming processes, etc. Nuclear reactor components such as fuel bundles, coolant channels, seal discs, end fittings require such analysis. A finite element code for thermal viscoplastic analysis of two dimensional structures has been developed. The code is tested against a number of sample problems. Two real life problems are solved using this code, namely creep analysis of sheath of nuclear fuel pin and creep analysis of a pressure vessel. The present report gives the details of the code and the problems solved using this code. (author). 7 refs., figs., 1 appendix.

26225 (DOE/ER/45461–11) **The deterministic prediction of failure of low pressure steam turbine disks.** Liu, Chun; Macdonald, D.D. Pennsylvania State Univ., University Park, PA (United States). Center for Advanced Materials. [1993]. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-91ER45461. (CONF-930998–2: Fall committee week of the National Association of Corrosion Engineers, Houston, TX (United States), 26 Sep - 1 oct 1993). Order Number DE93012922. Source: OSTI; NTIS; INIS; GPO Dep.

Localized corrosion phenomena, including pitting corrosion, stress corrosion cracking, and corrosion fatigue, are the principal causes of corrosion-induced damage in electric power generating facilities and typically result in more than 50% of the unscheduled outages. Prediction of damage, so that repairs and inspections can be made during scheduled outages, could have an enormous impact on the economics of electric power generation. To date, prediction of corrosion damage has been made on the basis of empirical/statistical methods that have proven to be insufficiently robust and accurate to form the basis for the desired inspection/repair protocol. In this paper, we describe a deterministic method for predicting localized corrosion damage. We have used the method to illustrate how pitting corrosion initiates stress corrosion cracking (SCC) for low pressure steam turbine disks downstream of the Wilson line, where a thin condensed liquid layer exists on the steel disk surfaces. Our calculations show that the SCC initiation and propagation are sensitive to the oxygen content of the steam, the environment in the thin liquid condensed layer, and the stresses that the disk experiences in service.

26226 (DOE/ER/45461–20) **The deterministic prediction of damage functions to low pressure steam turbines.** Liu, Chun; Macdonald, D.D. Pennsylvania State Univ., University Park, PA (United States). Center for Advanced Materials. [1993]. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-91ER45461. (CONF-930725–1: 3. EPRI steam turbine/generator workshop, Albany, NY (United States), 20-23 Jul 1993). Order Number DE93014218. Source: OSTI; NTIS; GPO Dep.

Localized corrosion phenomena, including pitting corrosion, stress corrosion cracking, and corrosion fatigue, are the principal causes of corrosion-induced damage in electric power generating facilities and typically result in more than 50% of the unscheduled outages. Prediction of damage, so that repairs and inspections can be made during scheduled outages, could have an enormous impact on the economics of electric power generation. To date, prediction of corrosion damage has been made on the basis of empirical/statistical methods that have proven to be insufficiently robust and accurate to form the basis for the desired inspection/repair protocol. In this paper, we describe a deterministic method for predicting localized corrosion damage. We have used the method to illustrate how pitting corrosion initiates stress corrosion cracking (SCC) for low pressure steam turbine disks downstream of the Wilson line, where a thin condensed liquid layer exists on the steel disk surfaces. Our calculations show that the SCC initiation and propagation are sensitive to the oxygen content of the steam, the environment in the thin liquid condensed layer, and the stresses that the disk experiences in service.

26227 (DOE/ER/45461–21) **Modeling the corrosion behaviors of the heat transport circuits of light water nuclear reactors.** Bertuch, A. (Pennsylvania State Univ., University Park, PA (United States). Center for Advanced Materials); Macdonald, D.D.; Pang, J.; Kriksunov, L.; Arioka, K. Pennsylvania State Univ., University Park, PA (United States). Center for Advanced Materials. [1993]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-91ER45461. (CONF-930825–1: 6. international symposium on environmental degradation of materials in nuclear power systems: water reactors, San Diego, CA (United States), 3-5 Aug 1993). Order Number DE93015033. Source: OSTI; NTIS; INIS; GPO Dep.

To model the corrosion behaviors of the heat transport circuits of light water reactors, a mixed potential model (MPM) has been developed and applied to both boiling water reactors (BWRS) and pressurized water reactors (PWRs). Using the data generated by the GE/UKEA-Harwell radiolysis model, electrochemical potentials (ECPs) have been calculated for the heat transport circuits of eight BWRs operating under hydrogen water chemistry (HWC). By modeling the corrosion behaviors of these reactors, the effectiveness of HWC at limiting IGSCC and IASCC can be determined. For simulating PWR primary circuits, a chemical-radiolysis model (developed by the authors) was used to generate input parameters for the NWM. Corrosion potentials of Type 304 and 316 SSs in PWR primary environments were calculated using the NWM and were found to be in good agreement with the corrosion potentials measured in the laboratory for simulated PWR primary environments.

26228 (EGG-M–92703) **Modeling of a horizontal steam generator for the submerged nuclear power station concept.** Palmrose, D.E.; Herring, J.S. EG and G Idaho, Inc., Idaho Falls, ID (United States). [1993]. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. (CONF-930778–2: 1993 RELAP5 international users meeting, Boston, MA (United States), 6-9 Jul 1993). Order Number DE93013665. Source: OSTI; NTIS; INIS; GPO Dep.

A submerged nuclear power station has been proposed as an alternative power station with a relatively low environmental impact for use by both industrialized and developing countries. The station would be placed 10 m above the seabed at a depth of 30–100 m and a distance of 10–30 km from shore. The submerged nuclear power station would be manufactured and refueled in a central facility, thus gaining the economies of factoryfabrication and the flexibility of short-lead-time deployment. To minimize the size of the submerged hull, horizontal steam generators are proposed for the primary-to-secondary heat transfer, instead of the more traditional vertical steam generators. The horizontal steam generators for SNPS would be similar in design to the horizontal steam generators used in the N-Reactors except the tube orientation is horizontal (the tube's inlet and outlet connection points on the tubesheet are at the same elevation). Previous RELAP5 input decks for horizontal steam generators have been either very simplistic (Loviisa PWR) or used a vertical tube orientation (N-Reactor). This paper will present the development and testing of a RELAP5 horizontal steam generator model, complete with a simple secondary water level control system, that accounts for the dynamic flow conditions which exist inside horizontal steam generators.

26229 (ETDE-IT–93-187) **Investigation on stress indices C3, K3, C'3 for gross structural discontinuities of piping systems.** Milella, P.P.; Pino, G.; Ronchi, U.; Capello, R.; Orlandi, S.; Zanaboni, P. ENEA, Rome (Italy). Direzione Sicurezza Nazionale e Protezione Sanitaria; ENEA, Bologna (Italy); Ansaldo SpA, Genoa (Italy). 1992. 7p. (CONF-921003–12: International conference on design and safety of advanced nuclear power plants, Tokyo (Japan), 25-28 Oct 1992). Order Number DE93799274. Source: OSTI; NTIS (US Sales Only); INIS.

The paper presents the first results of a research activity promoted in Italy by ENEA (Italian Agency for Energy, New Technologies and the Environment) and carried out in the framework of the ENEA-ANSALDO consortium, GENESI, aimed at assessing the aging of gross discontinuities such as reducers, transitions and penetrations subjected to severe thermal transients such as those produced by the sudden admittance of steam (or hot water) into piping at ambient temperature, which ran result in low cycle fatigue failure. In particular, the paper addresses the problem of design by rule, as per ASME NB 3600, where stress indices, or intensification factors (SIF) are needed and full-scale testing is mandatory to validate them. Here SIF's are derived through refined 2D-3D finite elements analysis for 20 different geometries, only 9 of which were covered by the ASME Code, the others being without any available SIF. Results indicate that the ASME factors are not always conservative and, that an integrated approach to the problem is required were SIF's evaluated by calculations must be checked on full scale structures and non-destructive examination procedures applied to demonstrate the capability to detect the early appearance of a tiny crack produced by thermal stresses in complex geometries.

26230 (FEI–2009) **Experimental study into stratified coolant flow in power plant elements.** Opanasenko, A.N. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk (Russian Federation). Fiziko-Ehnergeticheskij Inst. 1989. [12p.] (In Russian). Order Number DE93629673. Source: OSTI; NTIS (US Sales Only); INIS.

The article presents the results of investigations into temperature field and coolant flow structures using the models of mixing chambers, pipelines, annular gaps of vessel-type reactors under stationary and dynamic operation conditions. The results of experimental investigation of coolant temperature stratification using the models of the FBR upper mixing chamber, pipeline and annular gap of WWER-type reactor are given. Frude critical number is determined for occurrence of temperature stratification in pipelines, and dependences are derived for calculating the height of cold liquid jet penetration in a warmer medium and hot liquid wedge length in pipelines. The investigation results show that stratification changes drastically the dynamics and structure of thermohydraulic processes. Time and space scales of different types of secondary flows, their stability are related to averaged flow characteristics and flow microstructure as well. 5 refs.; 6 figs.

26231 (FEI–2015) **Turbulent interchannel momentum exchange in reactor fuel assemblies.** Zhukov, A.V.; Sorokin, A.P.; Titov, P.A.; Ushakov, P.A. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk (Russian Federation). Fiziko-Ehnergeticheskij Inst. 1989. [21p.] (In Russian). Order Number DE93629674. Source: OSTI; NTIS (US Sales Only); INIS.

A method is proposed for processing the results of experimental hydrodynamic investigations to determine the values of coefficients of momentum interchannel exchange through the mechanism of turbulent exchange in smooth rod bunches; the results of experimental data processing are presented. The obtained data are compared with the results produced by the flare method. The calculated ratio for coefficient of momentum interchannel exchange in smooth rod bunches is derived on the basis of the assumptions about substance exchange. 26 refs.; 4 figs.; 2 tabs.

26232 (IAEA-TECDOC–700, pp. 57-62) **ROMADIS - A rotating machinery diagnosis system.** Ding, Y. (Gesellschaft fuer Anlagen- und Reaktorsicherheit mbH, Garching (Germany)). International Atomic Energy Agency, Vienna (Austria). Apr 1993. (CONF-9209356–: Specialists meeting/workshop on the potential of knowledge based systems in nuclear installations, Erlangen (Germany), 21-25 Sep 1992). In *The potential of knowledge based systems in nuclear installations: Report of a specialists' meeting/workshop held in Erlangen, Germany, 21-25 September 1992.* [97p.] Order Number DE93629675. Source: OSTI; NTIS (US Sales Only); INIS.

This paper describes the PC-based software package ROMADIS developed for the rotating machinery diagnosis. It contains advanced signal processing techniques for extracting multi-features from the time records and uses a modified decision tree technique for the knowledge acquisition, the knowledge representation and the failure diagnosis process. It is user-friendly programmed and the diagnostic results are very easy to be verified. (author). 5 refs, 3 figs.

26233 (INIS-mf–12758, pp. 15-16) **'Crud' detection and evaluation during the Embalse nuclear power plant's thermal cycle for powers of 100%.** Fernandez, A. (Comision Nacional de Energia Atomica, Embalse (Argentina). Central Nuclear en Embalse); Rosales, A.H.; Mura, V.R.; Sentupery, C.; Rascon, H. Asociacion Argentina de Tecnologia Nuclear, Buenos Aires (Argentina). 1987. [735p.] (In Spanish). (CONF-8711355–: 15. scientific meeting and 4th Latin American meeting and 1st sessions on nuclear power plants, San Carlos de Bariloche (Argentina), 2-6 Nov 1987). In *Proceedings of the fifteenth scientific meeting; fourth Latin American meeting; first sessions on nuclear power plants.* Order Number DE91003052. Source: OSTI; NTIS (US Sales Only); INIS.

This paper describes the 'crud' measurements performed during the Embalse nuclear power plant's thermal cycle for a power of 100% (645 MWe) under different purification conditions. The aim of this work is to optimize the four steam generators' tube plate cleaning in function of the sweeping produced by their purification. (Author).

26234 (INIS-mf–12758, pp. 33-38) **Mechanical damage and corrosion in the primary system purification cooler.** Sainz, R.A. (Investigacion Aplicada SE (INVAP), San Carlos de Bariloche (Argentina)); Fiorini, R.H.; Semino, C.J. Asociacion Argentina de Tecnologia Nuclear, Buenos Aires (Argentina). 1987. [735p.] (In Spanish). (CONF-8711355–: 15. scientific meeting and 4th Latin American meeting and 1st sessions on nuclear power plants, San Carlos de Bariloche (Argentina), 2-6 Nov 1987). In *Proceedings of the fifteenth scientific meeting; fourth Latin American meeting; first sessions on nuclear power plants.* Order Number DE91003052. Source: OSTI; NTIS (US Sales Only); INIS.

Through the routine measurements of tritium activity and isotopic content in the exchanger's cooling water, a loss of heavy water was detected. During the decommissioning programmed for October 1986, the equipment was dismantled and the tubes losses were identified through helium fugue tests; subsequently, a 100% inspection of the tubes by atmospheric currents were performed, verifying reductions exceeding 50% of the original width in 70 tubes of the first section at the top plate level. These indications were verified through the study of the two extracted tubes, one of them observing a passing failure where marks appeared at all levels of the support and corrosion plates through splits at the top plates level. The corrosion causes were due to the low cooling flow which results from the primary system's reduction regarding the purification flow design, thus permitting the deposits accumulation. (Author).

26235 (INIS-mf–12758, pp. 63-66) **Development and production of nuclear valves. Forging and welding. Pt. 2.** Bernal Castro, J.B. (Metalurgica Bellucci SA, Lanus (Argentina)); Perez, J.C.; Labonia, R.N. Asociacion Argentina de Tecnologia Nuclear, Buenos Aires (Argentina). 1987. [735p.] (In Spanish). (CONF-8711355–: 15. scientific meeting and 4th Latin American meeting and 1st sessions on nuclear power plants, San Carlos de Bariloche (Argentina), 2-6 Nov 1987). In *Proceedings of the fifteenth scientific meeting; fourth Latin American meeting; first sessions on nuclear power plants.* Order Number DE91003052. Source: OSTI; NTIS (US Sales Only); INIS.

The first part of this work deals with the obtainment of the austenitic stainless steel DIN 1.4541 (AISI 321) stabilized titanium for Atucha II nuclear valves. The second part presented herein, continued with the development process and part of the production of the bodies' forging and valves leads. This development has been also carried out in the country and a detailed set up of the process with its corresponding Inspection and Assay Program was needed. The last part of this stage has been initiated at the welding process, so it was necessary to develop specific welding procedures to qualify them and use the equipment specially applied to this requirement. The set of assays and criteria certification for the qualifications is presented. (Author).

26236 (INIS-mf–12758, pp. 159-163) **Modal analysis application for dynamic characterization of simple structures.** Pastorini, A.J. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina). Gerencia de Desarrollo); Belinco, C.G.; Zubiaga,

J. Asociacion Argentina de Tecnologia Nuclear, Buenos Aires (Argentina). 1987. [735p.] (In Spanish). (CONF-8711355–: 15. scientific meeting and 4th Latin American meeting and 1st sessions on nuclear power plants, San Carlos de Bariloche (Argentina), 2-6 Nov 1987). In *Proceedings of the fifteenth scientific meeting; fourth Latin American meeting; first sessions on nuclear power plants.* Order Number DE91003052. Source: OSTI; NTIS (US Sales Only); INIS.

The knowledge of the dynamic characteristics of a structure helps to foresee the vibrating behaviour under operating conditions. The modal analysis techniques offer a method to perform the dynamic characterization of a studied structure from the vibration modes of such structure. A hammer provided with a loaded cell to excite a wide frequency band and accelerometer and, on the basis of a measurement of the transfer function at different points, various simple structures were given with a dynamic structures analysis (of the type of Fourier's rapidly transformation) and the results were compared with those obtained by other methods. Different fields where these techniques are applied, are also enumerated. (Author).

26237 (INIS-mf–12758, pp. 164-170) **Tensions and displacements calculation produced by a welding process in a nuclear power plant steam generator entrance by the finite element method.** Sanzi, H.C. (Empresa Nuclear Argentina de Centrales Electricas SA (ENACE), Buenos Aires (Argentina)). Asociacion Argentina de Tecnologia Nuclear, Buenos Aires (Argentina). 1987. [735p.] (In Spanish). (CONF-8711355–: 15. scientific meeting and 4th Latin American meeting and 1st sessions on nuclear power plants, San Carlos de Bariloche (Argentina), 2-6 Nov 1987). In *Proceedings of the fifteenth scientific meeting; fourth Latin American meeting; first sessions on nuclear power plants.* Order Number DE91003052. Source: OSTI; NTIS (US Sales Only); INIS.

This paper presents the results obtained from the tensions state and the displacements field of thermal origin, generated by a caloric source during the welding process. All the surfaces in contact with heavy water in a PHWR plant (Reactor of Pressurized Heavy Water) must be of austenitic stainless steel according to standard DIN 1.4550 or must be internally covered with this material. In the case of the primary loop components, -as the steam generator-, the walls of ferritic steel are covered with an austenitic stainless steel cladding. This cladding is applied by the welding process of immersed arc. Special attention is given during calculation, on the deformation produced in the holes of the bolts that link the entrance with the external lead. The distribution of nodal temperatures, as a function of time, is determined by a two-dimensional finite elements model during the welding process and the tension state and the displacement, by means of computational programs, were afterwards calculated. (Author).

26238 (KTM/E-B–124) **RATU - Nuclear power plant structural safety: Evaluation of research programme 1990-1992.** Hedner, G. (Statens kaernkraftsinspektion, Stockholm (Sweden)); Schultz, H.; Unneberg, L. Ministry of Trade and Industry, Helsinki (Finland). Energy Dept. Dec 1992. [30p.] Order Number DE93629676. Source: OSTI; NTIS; INIS.

Finland's energy research programmes.

The evaluation group is of the opinion that the work performed under the RATU programme is generally of high quality, in some areas, especially those related to water chemistry of excellent quality. The personnel gives the impression of being dedicated and enthusiastic, and the administration seems to be very effective. It is obvious that the RATU programme has taken advantage of related contracts and projects funded by different sources. It is the opinion of the valuation group that the investment and human capital have been brought to work very efficiently in all projects. The objectives of the programme and the different projects are formulated in a broad sense. The areas selected for work are however of high relevance to nuclear safety. In some projects not all aspects are addressed by the ongoing work, and further activities may be necessary to meet with the requirements of the authorities. (orig.).

26239 (LA-UR–93-1980) **Computational problems with the binomial failure rate model and incomplete common cause failure reliability data.** Kvam, P.H. Los Alamos National Lab., NM (United States). [1993]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9304154–1: Interface computing science and statistics, San Diego, CA (United States), 14-17 Apr 1993). Order Number DE93014346. Source: OSTI; NTIS; GPO Dep.

In estimating the reliability of a system of components, it is ordinarily assumed that the component lifetimes are independently distributed. This assumption usually alleviates the difficulty of analyzing complex systems, but it is seldom true that the failure of one component in an interactive system has no effect on the lifetimes of the other components. Often, two or more components will fail simultaneously due to a common cause event. Such an incident is called a common cause failure (CCF), and is now recognized as an important contribution to system failure in various applications of reliability. We examine current methods for reliability estimation of system and component lifetimes using estimators derived from the binomial failure rate model. Computational problems require a new approach, like iterative solutions via the EM algorithm.

26240 (NUREG/CR–4599-Vol.2-No.2) **Short Cracks in Piping and Piping Welds: Semiannual report, October 1991–March 1992: Volume 2, No. 2.** Wilkowski, G.M. (Battelle, Columbus, OH (United States)); Brust, F.; Francini, R.; Ghadiali, N.; Kilinski, T.; Krishnaswamy, P.; Landow, M.; Marschall, C.W.; Rahman, S.; Scott, P. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Engineering; Battelle, Columbus, OH (United States). May 1993. 121p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). (BMI–2173-Vol.2-No.2). Source: OSTI; NTIS; INIS; GPO.

This is the fourth semiannual report of the US Nuclear Regulatory Commission's Short Cracks in Piping and Piping Welds research program. This 4-Year program began in March 1990. The overall objective of this program is to verify and improve fracture analyses for circumferentially cracked large-diameter nuclear piping with crack sizes typically used in leak-before-break analyses or inservice flaw evaluations. Progress during this reporting period involved: (1) completing two through-wall-cracked pipe experiments and supplementary material property data, (2) an internal circumferential surface-cracked pipe experiment was completed which showed that the R/t effects on the Net-Section-Collapse Predicted loads for surface-cracked pipe to be independent of crack size, (3) the anisotropy investigation showed that pipe dimensions may be as important in determining the out-of-plane crack growth angle as the anisotropy of the toughness, (4) we initiated a probabilistic analysis of LBB to assess the potential changes in the leakage detection criteria in NRC Reg Guide 1.45, and (5) other efforts involved a sensitivity study on the effect of thermal aging of cast stainless steel on the moment-carrying capacity of the pipe as a function of time.

26241 (NUREG/CR–5410) **Statistically based reevaluation of PISC-II round robin test data.** Heasler, P.G. (Pacific Northwest Lab., Richland, WA (United States)); Taylor, T.T.; Doctor, S.R. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Engineering; Pacific Northwest Lab., Richland, WA (United States). May 1993. 164p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC06-76RL01830. (PNL–8577). Source: OSTI; NTIS; INIS; GPO.

This report presents a re-analysis of an international PISC-II (Programme for Inspection of Steel Components, Phase 2) round-robin inspection results using formal statistical techniques to account for experimental error. The analysis examines US team performance vs. other participants performance,flaw sizing performance and errors associated with flaw sizing, factors influencing flaw detection probability, performance of all participants with respect to recently adopted ASME Section 11 flaw detection performance demonstration requirements, and develops conclusions concerning ultrasonic inspection capability. Inspection data were gathered on four heavy section steel components which included two plates and two nozzle configurations.

26242 (NUREG/CR–6031) **Cavitation guide for control valves.** Tullis, J.P. (Tullis Engineering Consultants, Logan, UT (United States)). Nuclear Regulatory Commission, Washington, DC (United States). Div. of Engineering; Tullis Engineering Consultants, Logan, UT (United States). Apr 1993. 115p. Sponsored by

Nuclear Regulatory Commission, Washington, DC (United States). Source: OSTI; NTIS; INIS; GPO.

This guide teaches the basic fundamentals of cavitation to provide the reader with an understanding of what causes cavitation, when it occurs, and the potential problems cavitation can cause to a valve and piping system. The document provides guidelines for understanding how to reduce the cavitation and/or select control valves for a cavitating system. The guide provides a method for predicting the cavitation intensity of control valves, and how the effect of cavitation on a system will vary with valve type, valve function, valve size, operating pressure, duration of operation and details of the piping installation. The guide defines six cavitation limits identifying cavitation intensities ranging from inception to the maximum intensity possible. The intensity of the cavitation at each limit Is described, including a brief discussion of how each level of cavitation influences the valve and system. Examples are included to demonstrate how to apply the method, including making both size and pressure scale effects corrections. Methods of controlling cavitation are discussed providing information on various techniques which can be used to design a new system or modify an existing one so it can operate at a desired level of cavitation.

26243 (ORNL/FTR–4204) **[Life Management of Nuclear Power Plants]: Foreign trip report, February 15–22, 1992.** Pugh, C.E. Oak Ridge National Lab., TN (United States). 6 Mar 1992. 23p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93011109. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report discusses travel to attend the regular meeting of the IAEA IWG-LMNPP. This working group is part of the Nuclear Power Division and is primarily concerned with the integrity of primary and secondary systems f light-water reactor power plants. Historically, a special emphasis has been placed on pressure vessel integrity and the influence of neutron radiation. Reports were made by the representatives from each country and organization. The IAEA scientific secretary reported on the specialists' meetings held since the last IWG meeting (March 1990). The calendar of future meetings was identified firmly through 1993 and tentatively through 1995. (The United States will host one specialists' meeting in October 1992.) The traveler's report summarized activities in the US with an emphasis on license renewal. The traveler met with H. Schulz and J. Sievers of GRS to discuss plans for the October specialists' meeting, which is to be held in Oak Ridge and cosponsored by the Fracture Assessment Group (FAG) of the OECD's Committee on Safety of Nuclear Installations (CSNI). Dr. Schulz is Chairman of CSNI/FAG.

26244 (ORNL/FTR–4292) **The collaborative US/Japanese irradiation-effects investigations on material that has been removed from the pressure vessel of the Japanese Power Demonstration Reactor (JPDR): Foreign trip report, May 17–23, 1992.** Corwin, W.R.; Mayfield, M.E. Oak Ridge National Lab., TN (United States). 22 Jun 1992. 16p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93011074. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The travelers participated in three site visits, in order to investigate research on integrity of light-water reactor (LWR) pressure vessels. Discussions were held with personnel JAERI about collaborative US-Japanese studies of irradiation effects on material removed from the JPDR. Tentative agreement was reached to provide JPDR vessel pieces to the ORNL for examination of changes in microstructural and fracture properties. The studies at ORNL, to be conducted as part of the Heavy-Section Steel Irradiation (HSSI) Program will complement ongoing studies being conducted by JAERI. Presentations were made to the JAERI staff by W.R. Corwin on results of international assessment of large-scale fracture experiments conducted by the Fracture Assessment Group and M.E. Mayfield on shutdown of Yankee Rowe. During the visit to University of Tokyo, the status of the recent year's and the plans for the next year's work within the EPI Program were presented by the Japanese. The EPI Program is partially funded by the NRC through participation by ORNL. At the meeting with CRIEPI, results from the NRC-coordinated roundrobin on probabilistic failure analysis for pressurized thermal shock were presented by M.E. Mayfield, and discussions were held regarding the level of agreement of calculations performed by CRIEPI participants.

2203 Fuel Elements

Refer also to citation(s) 26182, 26194, 26268, 26271, 26295, 26300, 26302, 26307, 26312, 26333, 26341, 26676, 28038

26245 (FEI–2006) **Studying in the fuel-coolant interaction when simulating its return to the accidental package cavity.** Masagutov, R.F.; Kharitonov, S.R.; Kozlov, F.A.; Zagorul'ko, Yu.I.; Rogova, N.N. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk (Russian Federation). Fiziko-Ehnergeticheskij Inst. 1989. [11p.] (In Russian). Order Number DE93629679. Source: OSTI; NTIS (US Sales Only); INIS.

The article presents the results of investigations into dynamic characteristics of bismuth melt-water interaction when simulating accidents at nuclear reactors with core materials melting and their subsequent interaction with coolant. The simulation of accident interaction was performed at a vertical faility consisting of a water-filled interaction chamber and melting chamber located above it. Bismuth melting and overheating were performed in argon atmosphere. Bismuth melt (0.2-0.5 kg mass) was supplied into water inside a submersible termos. It is ascertained that there is a certain time interval between the beginning of the termos immersion under the water face level and constant of interacting media. A long delay (from 0.3 to 2.1 s) is observed between the initiation of the constant and steam explosion. Steam explosions occurred outside the termos cavity. The coefficient of thermal power conversion into mechanical one during the interaction reached 1-2%. Melt mass growth resulted in a proportional increase of pressure pulsation period. 2 refs.; 3 figs.; 1 tab.

26246 (IAEA-TECDOC–697) **Fission gas release and fuel rod chemistry related to extended burnup: Proceedings of a technical committee meeting held in Pembroke, Ontario, Canada, 28 April - 1 May 1992.** International Atomic Energy Agency, Vienna (Austria). Apr 1993. [235p.] (CONF-9204252–: Technical committee meeting on fission gas release and fuel rod chemistry related to extended burnup, Pembroke (Canada), 28 Apr - 1 may 1992). Order Number DE93628297. Source: OSTI; NTIS (US Sales Only); INIS.

The purpose of the meeting was to review the state of the art in fission gas release and fuel rod chemistry related to extended burnup. The meeting was held in a time when national and international programmes on water reactor fuel irradiated in experimental reactors were still ongoing or had reached their conclusion, and when lead test assemblies had reached high burnup in power reactors and been examined. At the same time, several out-of-pile experiments on high burnup fuel or with simulated fuel were being carried out. As a result, significant progress has been registered since the last meeting, particularly in the evaluation of fuel temperature, the degradation of the global thermal conductivity with burnup and in the understanding of the impact on fission gas release. Fifty five participants from 16 countries and one international organization attended the meeting. 28 papers were presented. A separate abstract was prepared for each of the papers. Refs, figs, tabs and photos.

26247 (IAEA-TECDOC–697, pp. 44-52) **Fission gas release behavior of high burnup fuels during power ramp tests.** Aoki, T. (Nuclear Power Engineering Center, Tokyo (Japan)); Koizumi, S.; Umehara, H.; Ogata, K. International Atomic Energy Agency, Vienna (Austria). Apr 1993. (CONF-9204252–: Technical committee meeting on fission gas release and fuel rod chemistry related to extended burnup, Pembroke (Canada), 28 Apr - 1 may 1992). In *Fission gas release and fuel rod chemistry related to extended burnup: Proceedings of a technical committee meeting held in Pembroke, Ontario, Canada, 28 April - 1 May 1992.* [235p.] Order Number DE93628297. Source: OSTI; NTIS (US Sales Only); INIS.

The Nuclear Power Engineering Test Center (NUPEC) conducted the MITI-sponsored Verification Test Program on High Performance Fuel to investigate the ramp behavior of Zr-linear fuels. This paper discusses fission gas behavior by correlating gas release data and pellet microstructural changes. 1 ref., 9 figs, 1 tab., 2 photos.

26248 (INIS-mf–12758, pp. 408-412) **General features of conceptual design for the pilot plant to manufacture fuel rods from mixed oxides.** Quesada, C.A. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina). Dept. de Combustibles Nucleares); Adeliang, P.; Esteban, A.; Aparicio, G.; Friedenthal, M.; Orlando, O.S. Asociacion Argentina de Tecnologia Nuclear, Buenos Aires (Argentina). 1987. [735p.] (In Spanish). (CONF-8711355–: 15. scientific meeting and 4th Latin American meeting and 1st sessions on nuclear power plants, San Carlos de Bariloche (Argentina), 2-6 Nov 1987). In *Proceedings of the fifteenth scientific meeting; fourth Latin American meeting; first sessions on nuclear power plants.* Order Number DE91003052. Source: OSTI; NTIS (US Sales Only); INIS.

This paper conceptually describes: (1) the processes in the manufacturing lines; (2) the distribution of quality controls and glove boxes in manufacturing lines; (3) the Control and Radiological Safety Room; (4) the Dressing Room; (5) the requirements of the ventilation system. The plant will be located in the first floor of the Radiochemical Processes Laboratory building, occupying a surface of 600 m^2. The necessary equipment for the following manufacturing lines will be provided: (a) conversion from Pu(NO3)4 to PuO 2 (through Pu(III)oxalate); (b) manufacture of homogeneous of mixed oxides of U and Pu; (c) manufacture of $(U,Pu)O_2$ pellets; (d) manufacture of fuel rods of mixed uranium and plutonium oxides. (Author).

26249 (INIS-mf–12758, pp. 413-417) **Equipment to weld fuel rods of mixed oxides.** Aparicio, G. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina). Dept. de Combustibles Nucleares); Orlando, O.S.; Olano, V.R.; Toubes, B.; Munoz, C.A. Asociacion Argentina de Tecnologia Nuclear, Buenos Aires (Argentina). 1987. [735p.] (In Spanish). (CONF-8711355–: 15. scientific meeting and 4th Latin American meeting and 1st sessions on nuclear power plants, San Carlos de Bariloche (Argentina), 2-6 Nov 1987). In *Proceedings of the fifteenth scientific meeting; fourth Latin American meeting; first sessions on nuclear power plants.* Order Number DE91003052. Source: OSTI; NTIS (US Sales Only); INIS.

Two welding outfits system T1G were designed and constructed to weld fuel rods with mixed oxides pellets (uranium and plutonium). One of them is connected to a glove box where the loading of sheaths takes place. The sheaths are driven to the welder through a removable plug pusher in the welding chamber. This equipment was designed to perform welding tests changing the parameters (gas composition and pressure, welding current, electrode position, etc.). The components of the welder, such as plug holder, chamber closure and peripheral accessories, were designed and constructed taking into account the working pressures in the machine, which is placed in a controlled area and connected to a glove box, where special safety conditions are necessary. The equipment to weld fuel bars is complemented by another machine, located in cold area, of the type presently used in the fuel elements factory. This equipment has been designed to perform some welding operations in sheaths and mixed oxide rods of the type Atucha I and II. Both machines have a programmed power supply of wide range and a vacuum, and pressurizing system that allows the change of parameters. Both systems have special features of handling and operation. (Author).

2204 Control Systems

Refer also to citation(s) 26115, 26116, 26193

26250 (BNL-NUREG–48522) **The development and evaluation of guidelines for the review of advanced human-system interfaces.** O'Hara, J.M. (Brookhaven National Lab., Upton, NY (US)); Wachtel, J. Brookhaven National Lab., Upton, NY (United States). [1992]. 11p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-921007–33: 20. water reactor safety information meeting, Bethesda, MD (United States), 21-23 Oct 1992). Order Number DE93015796. Source: OSTI; NTIS; INIS; GPO Dep.

Advanced control rooms for future nuclear power plants are being designed utilizing computer-based technologies. The US Nuclear Regulatory Commission reviews the human engineering aspects of such control rooms to ensure that they are designed to good human factors engineering principles and that operator performance and reliability are appropriately supported in order to protect public health and safety. This paper describes a general approach to advanced human-system interface review, development of human factors guidelines to support NRC safety reviews of advanced systems, and the results of a guideline test and evaluation program.

26251 (BNL-NUREG–48658) **Development of guidelines to review advanced human-system interfaces.** O'Hara, J.M. Brookhaven National Lab., Upton, NY (United States). [1993]. 4p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-930601–20: American Nuclear Society (ANS) annual meeting, San Diego, CA (United States), 20-24 Jun 1993). Order Number DE93014004. Source: OSTI; NTIS; INIS; GPO Dep.

Advanced control rooms (ACRS) will utilize advanced human-system interface (HSI) technologies that may have significant implications for plant safety in that they will affect the operators overall role in the system, the method of information presentation, and the ways in which operators interact with the system. The US Nuclear Regulatory Commission (NRC) reviews the HSI aspects of control rooms to ensure that they are designed to good human factors engineering principles and that operator performance and reliability are appropriately supported in order to protect public health and safety. The principal guidance available to the NRC, however, was developed more than ten years ago, well prior to these technological changes. Accordingly, the human factors guidance needs to be updated to serve as the basis for NRC review of these advanced designs. The purpose of this paper is to discuss the development, evaluation, and current status of the Advanced HSI Design Review Guideline, hereafter referred to as the "Guideline."

26252 (CONF-921007–29) **Technical basis for acceptance criteria on the susceptibility of digital systems to electromagnetic interference.** Ewing, P.D. (Oak Ridge National Lab., TN (US)); Korsah, K.; Antonescu, C. Oak Ridge National Lab., TN (United States). [1992]. 32p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC05-84OR21400. From 20. water reactor safety information meeting; Bethesda, MD (United States); 21-23 Oct 1992. Order Number DE93015448. Source: OSTI; NTIS; INIS; GPO Dep.

This paper discusses the development of the technical basis for establishing acceptance criteria on the susceptibility of digital systems to electromagnetic interference (EMI). The effort is sponsored by the US Nuclear Regulatory Commission and stems from the safety-related issues that need to be addressed with the application of digital instrumentation and controls systems in nuclear power plants. Designers of digital circuits are incorporating increasingly higher clock frequencies and lower logic voltage levels, thereby leading to the risk of susceptibility when spurious interference is misinterpreted as legitimate logic. Development of the technical basis for acceptance criteria centers around establishing good engineering practices to ensure that sufficient levels of electromagnetic compatibility (EMC) are maintained between the nuclear power plant's electronic and electromechanical systems. First, good EMC design and installation practices are needed to control the emissions from interference sources and their impact on other nearby circuits and systems. Then, a test and evaluation program is needed to outline the EMI tests to be performed, the associated test methods to be followed, and adequate test limits to ensure that the circuit or system under test meets the recommended guidelines. Test and evaluation should be followed by periodic maintenance to assess whether the recommended EMI control practices continue to be adhered to as part of the routine operation of the nuclear power plant. By following these steps, the probability of encountering safety-related problems associated with EMI will be greatly reduced.

26253 (CONF-930401–15) **Qualification issues for advanced light-water reactor protection systems.** Korsah, K. (Oak Ridge National Lab., TN (United States)); Clark, R.L.; Antonescu, C. Oak Ridge National Lab., TN (United States). [1993]. 13p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC05-84OR21400. From Meeting

on nuclear plant instrumentation, control and man-machine interface technologies; Oak Ridge, TN (United States); 18-21 Apr 1993. Order Number DE93010262. Source: OSTI; NTIS; INIS; GPO Dep.

The instrumentation and control (I&C) systems in advanced reactors will make extensive use of digital controls, microprocessors, multiplexing, and fiber optic transmission. Elements of these advances in I&C have been implemented on some current operating plants. However, the widespread use of the above technologies, as well as the use of artificial intelligence with minimum reliance on human operator control of reactors, highlights the need to develop standards for qualifying the I&C used in the next generation of nuclear power plants. As a first step in this direction, the protection system I&C for present-day plants was compared to that proposed for advanced light-water reactors (ALWRs). An evaluation template was developed by assembling a configuration of a safety channel instrument string for a generic ALWR, then comparing the impact of environmental stressors on that string to their effect on an equivalent instrument string from an existing light-water reactor. The template was then used to suggest a methodology for the qualification of microprocessor-based protection systems. The methodology identifies standards/regulatory guides (or lack thereof) for the qualification of microprocessor-based safety I&C systems. This approach addresses in part issues raised in NRC policy document SECY-91-292, which recognizes that advanced I&C systems for the nuclear industry are "being developed without consensus standards. as the technology available for design is ahead of the technology that is well understood through experience and supported by application standards."

26254 (CONF-9305215–1) **Addressing the susceptibility of digital systems to electromagnetic interference.** Ewing, P.D. (Oak Ridge National Lab., TN (US)); Korsah, K.; Antonescu, C. Oak Ridge National Lab., TN (United States). [1993]. 13p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC05-84OR21400. From IAEA specialists meeting on experience in ageing, maintenance and modernization of instrumentation and control systems for improving nuclear power plant availability; Rockville, MD (United States); 5-7 May 1993. Order Number DE93015434. Source: OSTI; NTIS; INIS; GPO Dep.

This paper discusses the development of the technical basis for acceptance criteria applicable to the immunization of digital systems against electromagnetic interference (EMI). The work is sponsored by the US Nuclear Regulatory Commission and stems from the safety-related issues that need to be addressed as a result of the application of digital instrumentation and control systems in nuclear power plants. Designers of digital circuits are incorporating increasingly higher clock frequencies and lower logic level voltages, thereby leading to potentially greater susceptibility of spurious interference being misinterpreted as legitimate logic. Development of the technical basis for acceptance criteria to apply to these digital systems centers around establishing good engineering practices to ensure that sufficient levels of electromagnetic compatibility (EMC) are maintained between the nuclear power plant's electronic and electromechanical systems. First, good EMC design and installation practices are needed to control the emissions from interference sources and thereby their impact on other nearby circuits and systems. Second, a verification and validation (V&V) program is needed to outline the EMI tests to be performed, the associated test methods to be followed, and adequate acceptance criteria to ensure that the circuit or system under test meets the recommended guidelines. V&V should be followed by periodic maintenance to assess whether the recommended EMI control practices continue to be adhered to as part of the routine operation of the nuclear power plant. By following these steps, the probability of encountering safety-related instrumentation susceptibility attributable to EMI will be greatly reduced.

26255 (EDF–93-NB-00004) **Human reliability and human factors in complex organizations: epistemological and critical analysis - practical avenues to action.** Llory, A. Electricite de France (EDF), 92 - Clamart (France). Aug 1991. [13p.] (In French). Order Number DE93631492. Source: OSTI; NTIS (US Sales Only); INIS.

This article starts out with comment on the existence of persistent problems inherent to probabilistic safety assessments (PSA). It first surveys existing American documents on the subject which make a certain number of criticisms on human reliability analyses, e.g. limitations due to the scant quantities of data available, lack of a basic theoretical model, non-reproducibility of analyses, etc. The article therefore examines and criticizes the epistemological bases of these analyses. One of the fundamental points stressed is that human reliability analyses do not take account of all the special features of the work situation which result in human error (so as to draw up statistical data from a sufficiently representative number of cases), and consequently lose all notion of the 'relationships' between human errors and the different aspects of the working environment. The other key points of criticism concern the collective nature of work which is not taken into account, and the frequent confusion between what operatives actually do and their formally prescribed job-tasks. The article proposes aspects to be given thought in order to overcome these difficulties, e.g. quantitative assessment of the social environment within a company, non-linear model for assessment of the accident rate, analysis of stress levels in staff on off-shore platforms. The method approaches used in these three studies are of the same type, and could be transposed to human-reliability problems. The article then goes into greater depth on thinking aimed at developing a 'positive' view of the human factor (and not just a 'negative' one, i.e. centred on human errors and organizational malfunctions), applying investigation methods developed in the occupational human sciences (occupational psychodynamics, ergonomics, occupational sociology). The importance of operatives working as actors of a team is stressed.

26256 (IAEA-TECDOC–700) **The potential of knowledge based systems in nuclear installations: Report of a specialists' meeting/workshop held in Erlangen, Germany, 21-25 September 1992.** International Atomic Energy Agency, Vienna (Austria). Apr 1993. [97p.] (CONF-9209356–: Specialists meeting/workshop on the potential of knowledge based systems in nuclear installations, Erlangen (Germany), 21-25 Sep 1992). Order Number DE93629675. Source: OSTI; NTIS (US Sales Only); INIS.

The integration of the knowledge based systems (KBS) with processes is a new challenge for artificial intelligence developments. Integration requires improved robustness of the KBS, using methodologies which cater for building well structured, modular applications, and for verification and validation. The following key points related to KBS development were discussed during the meeting: state of the art in knowledge representation and reasoning; methods for building KBS; tools and computers used for building and implementing KBS; requirements for verification and validation; communication between KBS and the process, and between the KBS and the operators. 9 papers were presented by participants. A separate abstract was prepared for each of the papers. Refs and figs.

26257 (IAEA-TECDOC–700, pp. 17-27) **Expert system application and neural network development for nuclear safety improvement.** Viron, F. de (TRACTEBEL, Brussels (Belgium)); Vlaminck, M. de. International Atomic Energy Agency, Vienna (Austria). Apr 1993. (CONF-9209356–: Specialists meeting/workshop on the potential of knowledge based systems in nuclear installations, Erlangen (Germany), 21-25 Sep 1992). In *The potential of knowledge based systems in nuclear installations: Report of a specialists' meeting/workshop held in Erlangen, Germany, 21-25 September 1992.* [97p.] Order Number DE93629675. Source: OSTI; NTIS (US Sales Only); INIS.

The paper presents the experience gained during the development of two applications of artificial intelligence in the nuclear safety field. The first one describes the Operator Advisor expert system developed at Tractebel to assist plant operators for optimal recovery following an accident. The second application deals with a research work in the field of artificial neural networks. The objective of the system is to perform an early warning of plant disturbances. 4 refs, 4 figs.

26258 (IAEA-TECDOC–700, pp. 29-38) **FBOLES: An expert system for fault diagnoses of nuclear power plants.** Zhang Qin (Tsinghua Univ., Beijing, BJ (China). Inst. of Nuclear Energy Technology); Gu Jin; An Xuegao; Xi Shuren; Xue Dazhi. International Atomic Energy Agency, Vienna (Austria). Apr 1993. Contract IAEA-6060/RB. (CONF-9209356–: Specialists meeting/workshop on the

potential of knowledge based systems in nuclear installations, Erlangen (Germany), 21-25 Sep 1992). In *The potential of knowledge based systems in nuclear installations: Report of a specialists' meeting/workshop held in Erlangen, Germany, 21-25 September 1992.* [97p.] Order Number DE93629675. Source: OSTI; NTIS (US Sales Only); INIS.

The basic concept of a Frequency-Based On-Line Expert System (FBOLES) approach for the on-line fault diagnoses of nuclear power plants has been previously presented in our companion papers. This paper reports the status of the software development and some of our experiment results. The main steam and feedwater condensate systems (MSFCS, namely the secondary loop) of a nuclear power plant simulated by the Tsinghua simulator has been selected as a target system of the present stage of development. The knowledge bases for MSFCS has been initially constructed. A total of 62 signals from the simulator have been selected as the on-line evidence for diagnosis. As a software package, FBOLES can perform either the on-line diagnosis where the signals are input from the simulator directly or the off-line diagnosis where the signals are input by users from the keyboard. Also, the information base including the knowledge bases can be modified by users easily and can be compiled by FBOLES into coded format that is really used in diagnosis. (author). 4 refs, 9 figs.

26259 (IAEA-TECDOC–700, pp. 39-48) **ERB - Graphic knowledge base editor.** Sikora, J. (Ustav Jaderneho Vyzkumu CSKAE, Rez (Czech Republic)); Zbytovsky, V.; Vasa, I.; Fiser, V.; Tschiesche, J.; Mickal, V. International Atomic Energy Agency, Vienna (Austria). Apr 1993. (CONF-9209356–: Specialists meeting/workshop on the potential of knowledge based systems in nuclear installations, Erlangen (Germany), 21-25 Sep 1992). In *The potential of knowledge based systems in nuclear installations: Report of a specialists' meeting/workshop held in Erlangen, Germany, 21-25 September 1992.* [97p.] Order Number DE93629675. Source: OSTI; NTIS (US Sales Only); INIS.

The paper describes the present state and future prospects of the Expert System for Operator Support (ESOS) developed at the Nuclear Research Institute at Rez near Prague (NRI). Special emphasis is put on knowledge acquisition and knowledge base representation means - ERB. ERB is a package of programs, which enables the user to create, edit and compile a knowledge base of the Expert System RECON, to create and edit testing data and to test knowledge base (KB). The knowledge base is displayed in the form of a graph, where nodes represent the rules and arcs represent the relations "PREDECESSOR → SUCCESSOR." The filling of KB is integrated with the design of their graphical representation. Owing to this, the form of the KB representation makes the whole KB more understandable. The filling process of KB corresponds with general methodologies, where in the first step nodes with identifiers and texts are defined, in the second step relations between them are specified, in the third step the predecessor is defined and finally, relations between nodes are concretized. The paper contains a description of the functions offered by the ERB. (author). 2 refs, 5 figs.

26260 (IAEA-TECDOC–700, pp. 77-80) **A personal computer program for emergency operating procedures support.** Salamun, I. (Institut Jozef Stefan, Ljubljana (Yugoslavia)); Mavko, B.; Stritar, A. International Atomic Energy Agency, Vienna (Austria). Apr 1993. (CONF-9209356–: Specialists meeting/workshop on the potential of knowledge based systems in nuclear installations, Erlangen (Germany), 21-25 Sep 1992). In *The potential of knowledge based systems in nuclear installations: Report of a specialists' meeting/workshop held in Erlangen, Germany, 21-25 September 1992.* [97p.] Order Number DE93629675. Source: OSTI; NTIS (US Sales Only); INIS.

EmDiSy is the computer code for the presentation of emergency operating procedures. It uses knowledge from the database file and presents it to the operator in different visualization forms. It starts with high priority procedure and then leads the operator through procedures respective to the nuclear power plant condition. Each procedure is represented by six different windows. The first three windows describe the purpose of the procedure, the symptoms and entry conditions of the system and the automatic actions at appointed condition. The next three windows represent a tree of steps through the active procedure, describes action in the active step and represents a 3D picture of the system or 2D picture of status trees. They include parameter values needed in the procedure to describe plant condition. Pictures drawn in 3D parallel projection clearly describe the condition of the system and action that must be taken. In a special window EmDiSy presents connection between procedures. EmDiSy clearly shows to the operator actions that must be taken during emergencies in a nuclear power plant and points into the realistic place of the action. EmDiSy could be extended with the advanced system to give the operator advice respective to nuclear power plant condition. (author). 3 refs, 4 figs.

26261 (IAEA-TECDOC–700, pp. 87-93) **A situation related, mnemonic tool for expert tasks.** Simon, L. (FORWISS, Erlangen (Germany)). International Atomic Energy Agency, Vienna (Austria). Apr 1993. (CONF-9209356–: Specialists meeting/workshop on the potential of knowledge based systems in nuclear installations, Erlangen (Germany), 21-25 Sep 1992). In *The potential of knowledge based systems in nuclear installations: Report of a specialists' meeting/workshop held in Erlangen, Germany, 21-25 September 1992.* [97p.] Order Number DE93629675. Source: OSTI; NTIS (US Sales Only); INIS.

Practical tasks far too complex and responsible to be performed automatically by intelligent systems, such as 'operating nuclear power plants in dangerous situations', require intelligent operation manuals to support human experts. During task performance operation manuals are usually accessed by using included descriptions of task flow. As with simple tasks, the standard way to describe flow of complex expert tasks is to present complete instructional sequences or collections of associations between situations and possible activities. However, both approaches fail to describe adequately expert task flow, and therefore are not able to provide appropriate access to operation manuals for expert tasks. In this article we will present a newly developed formal language for adequately describing the flow of expert tasks, called 'ExpertStruct', which includes an inference engine to compute - given a task description and a present situation - possible continuations of the task. If a description of an expert task based on the language is integrated into a hypertext operation manual, it can provide appropriate, situation-related access to stored information. It acts as a mnemonic tool for monitoring and controlling task flow, which relates itself automatically to the present situation. (author). 20 refs, 4 figs.

26262 (INIS-mf–12758, pp. 601-607) **Instrumentation and control engineering at ENACE (Argentine Nuclear Enterprise of Electric Power Plants S.A.).** Roca, J.L. (Empresa Nuclear Argentina de Centrales Electricas SA (ENACE), Buenos Aires (Argentina)); Garzon, D. Asociacion Argentina de Tecnologia Nuclear, Buenos Aires (Argentina). 1987. [735p.] (In Spanish). (CONF-8711355–: 15. scientific meeting and 4th Latin American meeting and 1st sessions on nuclear power plants, San Carlos de Bariloche (Argentina), 2-6 Nov 1987). In *Proceedings of the fifteenth scientific meeting; fourth Latin American meeting; first sessions on nuclear power plants.* Order Number DE91003052. Source: OSTI; NTIS (US Sales Only); INIS.

This paper describes the techniques used in the project of instrumentation and control for the Atucha II nuclear power plant, from the original flow diagram of the system whose instrumentation and control is requested to the functional binary diagrams and control loops, through measurement sheets and other documentation. An account of the organization and handling of this mass of information is given, using an electronic processing system of data file for the project. A brief description of the task implied in the completing and updating of these files defines the scheme in which all the documentation development associated with a given process is included. (Author).

26263 (INIS-mf–12758, pp. 625-628) **Ergonomic analysis of work in energy control plants: factors to be observed.** Rivas, R. (Fundacion REFA Argentina, Buenos Aires (Argentina)). Asociacion Argentina de Tecnologia Nuclear, Buenos Aires (Argentina). 1987. [735p.] (In Spanish). (CONF-8711355–: 15. scientific meeting and 4th Latin American meeting and 1st sessions on nuclear power plants, San Carlos de Bariloche (Argentina), 2-6 Nov 1987). In *Proceedings of the fifteenth scientific meeting; fourth Latin*

American meeting; first sessions on nuclear power plants. Order Number DE91003052. Source: OSTI; NTIS (US Sales Only); INIS.

To make evident the incidence of the technology modification due to the increasing automation of energy control plants on man, whose activity is limited to observation and control, with low working metabolism and high attention and concentration. The methodology is fundamentally based on the individual analysis of the factors affecting man. The following will be considered: (a) load volume: the load volume generated by the above mentioned activity depends on the observation period, the number of indicators to be observed and the frequency of control activities; (b) active participation: the lack of active participation due to a motionless task requires a constant yield disposition to develop an unusual activity; (c) monotonous activity: the load is produced by maintaining a suitable physic-mental state through a volition effort; (d) change of disposition: this component, which is not willingly admitted, changes the mechanism of compared functions during the day, following a biological law that depends from the hour; (e) environment influence: the unfavorable physical influences, like climate, lack of light, noise, etc. also affect man. The analysis of mental load is specially important due to its influence on the performance, the accident risk and the safety of the system to be controlled. (Author).

26264 (SR/H–546) **[Project 98-1086, Technical scopes of work, Instrument, February 9, 1959–January 7, 1963].** [Engineering Department project files]. Du Pont de Nemours (E.I.) and Co., Aiken, SC (United States). Savannah River Plant. [1963]. 137p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. Order Number DE93013447. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document provides the scope of work for the procurement and installation of instrumentation for the Heavy Water Components Test Reactor (HWCTR).

26265 (UCRL-JC–110425) **The "glass" control room and human error in the nuclear power plant.** Bennett, C.T.; Kimura, C.Y. Lawrence Livermore National Lab., CA (United States). 15 Oct 1992. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9301102–7: American Nuclear Society (ANS) meeting, Clearwater, FL (United States), 27 Jan 1993). Order Number DE93012597. Source: OSTI; NTIS; GPO Dep.

We discuss the design philosophy that should be applied to a nuclear facility using electronic, "glass" displays for presentation critical information. A brief history of and problems related to the use of electronic displays in the aviation industry is presented, along with the parallel history of the use of electronic displays in the nuclear power industry. These discussions are followed by a discussion of the display guidelines that should be considered to minimize human error, and maximize safety and performance.

2205 Environmental Aspects

Refer also to citation(s) 26111, 26179, 26350, 26396, 26462, 26879, 27366, 27433

26266 (CPL-B–226) **Community emergency response to nuclear power plant accidents: A selected and partially annotated bibliography.** Youngen, G. Council of Planning Librarians, Monticello, IL (United States). Oct 1988. 43p. Source: OSTI; INIS; American Planning Association, 1313 East 60th Street, Chicago, IL 60637 (US).

The role of responding to emergencies at nuclear power plants is often considered the responsibility of the personnel onsite. This is true for most, if not all, of the incidents that may happen during the course of the plant's operating lifetime. There is however, the possibility of a major accident occurring at anytime. Major nuclear accidents at Chernobyl and Three Mile Island have taught their respective countries and communities a significant lesson in local emergency preparedness and response. Through these accidents, the rest of the world can also learn a great deal about planning, preparing and responding to the emergencies unique to nuclear power. This bibliography contains books, journal articles, conference papers and government reports on emergency response to nuclear power plant accidents. It does not contain citations for "onsite" response or planning, nor does it cover the areas of radiation releases from transportation accidents. The compiler has attempted to bring together a sampling of the world's collective written experience on dealing with nuclear reactor accidents on the sate, local and community levels. Since the accidents at Three Mile Island and Chernobyl, that written experience has grown enormously.

26267 (DOE-HMIP-RR–92.110) **Assessment of options for the treatment of Sizewell PWR liquid effluent.** Hornby, J.; Allam, J.; Knibbs, R.H. AEA Technology, Harwell (United Kingdom). 1992. [134p.] Sponsored by Department of the Environment, London (United Kingdom). Her Majesty's Inspectorate of Pollution. Contract PECD-7/9/431;A1/CF/744. Order Number DE93631577. Source: OSTI; NTIS (US Sales Only); INIS.

This report describes the origins of PWR liquid waste streams, their composition and rates of arising. Data has been collected from operational PWRs and estimates obtained for Sizewell B PWR liquid waste streams. Current liquid waste treatment practices are reviewed and assessments made of established and novel treatment techniques which could be applicable to Sizewell B. A short list of treatment options is given and recommendations are made relating to established treatment technologies suitable for Sizewell B and also to development work on more novel treatments which could lead to a reduction in waste disposal volumes. (author).

26268 (DUN–3955) **Fission product release rate from aluminum clad uranium fuel.** Traxler, F.C. Douglas United Nuclear, Inc., Richland, WA (United States). 22 Mar 1968. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93012156. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The rate of fission product inventory release to the environment as a result of exposure of uranium fuel to high temperatures should be known to more realistically assess the consequences of a credible accident. To obtain an acceptable experimental evaluation of releases it is necessary to have similar conditions to those which would exist in the reactor. Fission product release rate experiments exploring temperatures below the uranium melting point were performed for Douglas United Nuclear by D. L. Reid of Battelle-Northwest. Data and some conclusions from the initial tests are presented in this report. The intent of distributing this information is to make known results and to record data transmitted in correspondence from Battelle-Northwest to DUN.

26269 (EUR–14043/5) **Assessment of management alternatives for LWR wastes. Volume 5. Assessment of the radiological impact to the public resulting from discharges of radioactive effluents.** Centner, B. (Belgatom SA, Brussels (Belgium)). Commission of the European Communities, Luxembourg (Luxembourg). 1993. [147p.] Source: OSTI; NTIS (US Sales Only); INIS.

This report deals with the assessment of the radiological impact to the public resulting from discharges of radioactive effluents (liquid and gaseous) in connection with the implementation of the Belgian scenario for the management of PWR waste. Both individual and collective doses have been estimated for a critical group of the population living around the nuclear power plants concerned. This study is part of an overall theoretical exercise aimed at evaluating a selection of management wastes for LWR waste based on economical and radiological criteria.

26270 (EUR–14043/7) **Assessment of management alternatives for LWR wastes. Volume 7. Cost and radiological impact associated with near-surface disposal of reactor waste (French concept).** Malherbe, J. (CEA, 75 - Paris (France)). Commission of the European Communities, Luxembourg (Luxembourg). 1993. [48p.] Contract FI1W/0135-F. Source: OSTI; NTIS (US Sales Only); INIS.

This report deals with the determination of the cost and the radiological impact associated with a near-surface disposal site (French concept) for low and medium-level radioactive waste generated during operation of a 20 GWe nuclear park composed of LWRs for 30 years. This study is part of an overall theoretical exercise aimed at evaluating a selection of management routes for LWR waste based on economical and radiological criteria.

26271 (HW–73026) **Production reactor process tube, dummy, and fuel element cladding film and radioactivity studies.** Perrigo, L.D. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 14 Mar 1962. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93012070. Source: OSTI; NTIS (US Sales Only); GPO Dep.

During the normal operation of reactors ionic, particulate and colloidal substances in the coolant are activated as they pass through the neutron flux. The parent substances for the activated materials come from several sources: transient corrosion products from the coolant system piping and fuel element cladding, coolant additives and coolant impurities. Previous studies have shown that a major portion of these substances do not simply pass through the neutron flux field but undergo complex sorption phenomena that result in effluent radio-nuclide levels considerably in excess of what would be expected from activation on a once-through basis. This report is being written to outline studies that will provide activity inventory data that will aid in defining radionuclide retention reactions in reactor coolant systems.

26272 (INIS-mf–12758, pp. 534-545) **Influence of precipitations, buildings and over increase of radioactive emission in the population dose calculation under accident conditions.** Conte, M.C. (Empresa Nuclear Argentina de Centrales Electricas SA (ENACE), Buenos Aires (Argentina)). Asociacion Argentina de Tecnologia Nuclear, Buenos Aires (Argentina). 1987. [735p.] (In Spanish). (CONF-8711355–: 15. scientific meeting and 4th Latin American meeting and 1st sessions on nuclear power plants, San Carlos de Bariloche (Argentina), 2-6 Nov 1987). In *Proceedings of the fifteenth scientific meeting; fourth Latin American meeting; first sessions on nuclear power plants.* Order Number DE91003052. Source: OSTI; NTIS (US Sales Only); INIS.

The influence of precipitations is analyzed, as well as of buildings and emission over increase on the dosis produced on the population as a consequence of some postulated accidents in Atucha II nuclear power plant. The following conclusions were achieved: the calculations performed without considering the above mentioned effects are conservative, excluding the case in which the precipitation is very close to the emission source. In this case, the maximal difference observed was 20% for class C and 5% for class D, at 1 km from source, with a decreasing difference according to the distance. The doses calculated without building effect were approximately 25% greater than those calculated considering this effect for class E and 40% for class F, at 1 km from the source. The difference decreases with distance and increases with the stability of atmospheric conditions. This behaviour is also observed with the over increase effect. In this case, the maximal observed differences were of one order of magnitude for class E and three orders for class F, at 1 km from the source. (Author).

26273 (NUREG/CR–5247-Vol.2) **RASCAL Version 2.0 workbook: Volume 2.** Athey, G.F. (Athey Consulting, Charles Town, WV (United States)); McKenna, T.J. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Operational Assessment; Athey Consulting, Charles Town, WV (United States). May 1993. 99p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Source: OSTI; INIS; GPO; NTIS (documentation only); ESTSC (complete software package), P.O. Box 1020, Oak Ridge, TN 37831-1020.

The Radiological Assessment System for Consequence Analysis, Version 2.0 (RASCAL 2.0) has been developed for use by the NRC personnel who respond to radiological emergencies. This workbook is intended to complement the RASCAL 2.0 User's Guide (NUREG/CR-5247, Vol. 1). The workbook contains exercises designed to familiarize the user with the computer based tools of RASCAL through hands-on problem solving. The workbook is composed of four major sections. The first part is a RASCAL familiarization exercise to acquaint the user with the operation of the forms, menus, on-line help, and documentation. The latter three parts contain exercises in using the three tools of RASCAL Version 2.0: DECAY, FM-DOSE, and ST-DOSE. Each section of exercises is followed by discussion on how the tools could be used to solve the problem.

26274 (NUREG/CR–5778-Vol.3) **New York/New Jersey regional seismic network: Final report for April 1985–September 1992: Volume 3.** Seeber, L. (Columbia Univ., Palisades, NY (US). Lamont-Doherty Earth Observatory); Johnson, D.; Armbruster, J. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Engineering; Columbia Univ., Palisades, NY (United States). Lamont-Doherty Earth Observatory. Jul 1993. 71p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Source: OSTI; NTIS; INIS; GPO.

For almost 20 years, Lamont-Doherty Earth Observatory has operated the primary network for monitoring earthquake activity in the New York State, northern New Jersey, and northwestern Vermont area, with support by both NRC and the USGS. The primary purpose of this research is directed toward the determination of local seismicity and the possible identification of associated geologic and tectonic features. From April 1985 to September 1992, the network recorded and located 346 regional earthquakes. Scientific activity, primarily in the form of aftershock monitoring, was concentrated upon a number of significant earthquakes: The Ardsley, NY; the Chardon, OH; the Ashtabula, OH; and the Saguenay, Canada earthquakes; in addition to the Summit, NY event. These studies involved the deployment of portable seismographs in the epicentral areas. Many of these sequences were in northeastern North America, but outside the L-DEO seismic network and were not covered by other permanent networks. Spatial correlations between structures and earthquakes were found at a wide range of scales, and systematic searches of archival material were used to improve constraints on historic sources.

26275 (ORNL/FTR–4118) **Modular High-Temperature Gas-Cooled Reactor COMEDIE Fission Product Transport Program: Foreign trip report, October 11–20, 1991.** Kimball, O.F. Oak Ridge National Lab., TN (United States). 5 Nov 1991. 44p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93011086. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The COMEDIE loop is an engineering-scale experimental loop that will be operated in the SILOE reactor pool at CENG to obtain an independent data base that can be used to validate MHTGR fission product transport codes. Testing will be done under representative MHTGR conditions with representative components. Designed-to-fail (dtf) fuel particles, under irradiation, will release fission products that will be transported and distributed through the fuel block, a graphite block representing the lower reflector element, and a gas/gas heat exchanger representing the metallic surfaces in the primary circuit of an MHTGR. A depressurization section in the loop produces blowdowns simulating possible depressurization events. The primary purpose of this review meeting was to prepare for the first irradiation test that will start in December 1991 (irradiation will begin in January 1992). All technical and programmatic issues to be solved before the start of the lint irradiation test were resolved.

26276 (ORNL/FTR–4178) **Final irradiation report for the HFR-B1 experiment and postirradiation examinations for HFR-B1: Foreign trip report, October 12–December 30, 1991.** Myers, B.F. Oak Ridge National Lab., TN (United States). 10 Jan 1992. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93011054. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report discusses travel to the JRC Petten was for the purpose of collaborating in preparing and writing the final irradiation report for experiment HFR-B1. At the end of the travel, the tasks remaining to be completed are the thermal calculations, corrections to the fission gas release data, and a part of the text. The estimated date of completion of a draft report by JRC is April 1992. Analysis of the experiment can nevertheless be started at present. In preparing data for the calculations, the dimensional change in H-451 graphite was found to be smaller in the presence of water vapor than in its absence. The postirradiation examination of HFR-B1 being conducted at the Forschungszentrum Juelich was reviewed. A new course was set for the hydrolysis experiments. The behavior of fission products was discussed by representatives from Germany, Japan, Russia, and the United States at the technical workshop held in Juelich. A planned International Atomic Energy Agency (IAEA) effort to initiate an international cooperative task on fission product behavior was presented and briefly discussed.

26277 (SSI–92-19) **Quality assurance of radiation monitoring performed of the swedish nuclear industry. Discharges of liquid wastes 1989.** Swedish Radiation Protection Inst., Stockholm (Sweden). Nov 1992. [33p.] (In Swedish). Order Number DE93630788. Source: OSTI; NTIS; INIS.

The swedish nuclear power plants have own administration of some radiation monitoring. These monitoring programs are quality controlled by the Swedish Radiation Protection Institute (SSI). The report presents the results of the quality control 1989. The following were controlled: Interlaboratory comparisons of Sr-90 measurements discharge of liquid wastes 1989. Discharge of plutonium 1988.

26278 (SSI–92-21) **Quality assurance of radiation monitoring performed at the swedish nuclear industry. Discharge of liquid wastes 1990.** Swedish Radiation Protection Inst., Stockholm (Sweden). Dec 1992. [34p.] (In Swedish). Order Number DE93630789. Source: OSTI; NTIS; INIS.

The swedish nuclear power plants have own administration of some radiation monitoring. These monitoring programs are quality controlled by the Swedish Radiation Protection Institute (SSI). The report presents the results of the quality control 1990. The following were controlled: Interlaboratory comparisons of measurements of gamma emitting nuclides in water. Discharge of liquid wastes. Discharge of plutonium.

2206 Research, Test, Training, Production, Irradiation, Materials Testing Reactors

Refer also to citation(s) 25633, 25831, 25904, 25905, 25908, 25920, 26143, 26165, 26167, 26220, 26264, 26268, 26271, 26337, 26338, 26339, 26340, 26341, 26342, 26350, 26373, 26374, 26375, 26376, 26377, 26378, 26379, 26380, 26381, 26382, 26383, 26385, 26388, 26389, 26390, 26391, 26392, 26393, 26394, 26395, 26585, 26587, 26714, 27250, 27251, 27252, 27253, 27255, 27366, 27379, 28088

26279 (BNL–48820) **Materials irradiation subpanel report to BESAC neutron sources and research panel.** Birtcher, R.C. (Argonne National Lab., IL (United States)); Goland, A.N.; Lott, R.; Odette, G.R. Brookhaven National Lab., Upton, NY (United States). 10 Sep 1992. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. Order Number DE93015198. Source: OSTI; NTIS; INIS; GPO Dep.

The future success of the nuclear power option in the US (fission and fusion) depends critically on the continued existence of a healthy national materials-irradiation program. Consideration of the requirements for acceptable materials-irradiation systems in a new neutron source has led the subcommittee to identify an advanced steady-state reactor (ANS) as a better choice than a spallation neutron source. However, the subcommittee also hastens to point out that the ANS cannot stand alone as the nation's sole high-flux mixed-spectrum neutron irradiation source in the next century. It must be incorporated in a broader program that includes other currently existing neutron irradiation facilities. Upgrading and continuing support for these facilities must be planned. In particular, serious consideration should be given to converting the HFIR into a dedicated materials test reactor, and long-term support for several university reactors should be established.

26280 (CONF-930702–21) **Full scale dynamic fracture testing of degraded pipe.** Poole, A.B.; Battiste, R.L.; Clinard, J.A. Oak Ridge National Lab., TN (United States). [1993]. 21p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Pressure vessels and piping conference; Denver, CO (United States); 25-29 Jul 1993. Order Number DE93012966. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Oak Ridge National Laboratory (ORNL) has completed a major task for the Department of Energy (DOE) in the demonstration that the primary piping of the New Production Reactor-Heavy Water Reactor (NPR-HWR), with its relatively moderate temperature and pressure, should not suffer an instantaneous double-ended-guillotine-break (DEGB) under design basis loadings and conditions. This paper provides the results of the second pipe test series in this program. In this series, a section of aged 304 stainless steel piping was loaded in fully reversed bending cycles at large loads. An initial flaw size was based on leakage flow testing at pressure and temperature for the NPR-HWR. The detectable leakage flaw was cycled in bending at large loads for 40 cycles. These test results are discussed in this paper.

26281 (DPES–1403) **[Plant Histories]: SRP construction history, Volume 4.** Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). Engineering Dept. Jan 1957. 374p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. (SR/H–578). Order Number DE93015311. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document, Volume 4, provides the construction history of the 300-M, 700-A, 400-D, and 500/600/900-G Areas of the Savannah River Plant.

26282 (DPSP–53-1-3-Del.Ver.) **Works Technical Department monthly progress report, March 1953.** Overbeck, W.P. Du Pont de Nemours (E.I.) and Co., Aiken, SC (United States). Savannah River Plant. 6 Apr 1953. 48p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. Order Number DE93016082. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report details activities of the Works Technical Department during the month of March, 1953.

26283 (DPSP–53-1-5-Del.Ver.) **Works Technical Department monthly progress report, May 1953.** Overbeck, W.P. Du Pont de Nemours (E.I.) and Co., Aiken, SC (United States). Savannah River Plant. 5 Jun 1953. 53p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. Order Number DE93016012. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report details activities of the Works Technical Department during the month of May, 1953.

26284 (DPSP–53-1-7-Del.Ver.) **Works Technical Department monthly progress report, July 1953.** Overbeck, W.P. Du Pont de Nemours (E.I.) and Co., Aiken, SC (United States). Savannah River Plant. 10 Aug 1953. 52p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. Order Number DE93016014. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report details activities of the Works Technical Department during the month of July, 1953.

26285 (DPSP–53-368) **Savannah River Plant history, all areas, August 1950–June 1953.** Du Pont de Nemours (E.I.) and Co., Aiken, SC (United States). Savannah River Plant. [1953]. 260p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. (SR/H–529). Order Number DE93012423. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document recounts Du Pont's management of the Savannah River Plant. The events covered by this initial volume of the SRP History occurred, in most cases, in the period beginning just prior to release by the Construction Division of the various facilities and ending July 1, 1953. The buildup of the Plant operating organization and the bases for major decisions are described in the sections devoted to the various departments. Basically, the operating organization was patterned after those in the Company's commercial plants of comparable size and diversification. The Company's commercial plant policies and practices had been adopted by the Atomic Energy Division and governed the decisions reached at the Savannah River Plant.

26286 (DPSP–54-1-8-Del.Ver.) **Works Technical Department monthly progress report, August 1954.** Du Pont de Nemours (E.I.) and Co., Aiken, SC (United States). Savannah River Plant. 15 Sep 1954. 88p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. Order Number DE93016039. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This monthly progress report details activities of the Works Technical Department during the month of August 1954.

26287 (DPSP–54-1-9-Del.Ver.) **Works Technical Department monthly progress report, September 1954.** Du Pont de Nemours (E.I.) and Co., Aiken, SC (United States). Savannah River Plant. 18 Oct 1954. 132p. Sponsored by USDOE, Washington, DC

(United States). DOE Contract AC09-76SR00001. Order Number DE93016030. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This monthly progress report details activities of the Works Technical Department during the month of September 1954.

26288 (DPSP–54-1-10-Del.Ver.) **Works Technical Department monthly progress report, October 1954.** Du Pont de Nemours (E.I.) and Co., Aiken, SC (United States). Savannah River Plant. 16 Nov 1954. 135p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. Order Number DE93016031. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This monthly progress report details activities of the Works Technical Department during the month of October 1954.

26289 (DPSP–54-1-11-Del.Ver.) **Works Technical Department monthly progress report, November 1954.** Du Pont de Nemours (E.I.) and Co., Aiken, SC (United States). Savannah River Plant. 20 Dec 1954. 139p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. Order Number DE93016035. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report details activities of the Works Technical Department during the month of November, 1954.

26290 (DPSP–54-448) **Savannah River Plant history, all areas, July 1953–June 1954.** Du Pont de Nemours (E.I.) and Co., Aiken, SC (United States). Savannah River Plant. [1954]. 438p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. (SR/H–532). Order Number DE93012786. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document recounts Du Pont's management of the Savannah River Plant. The events covered by this volume of the SRP History occurred during the period of July 1953 through June 1954.

26291 (DPSP–55-1-1-Del.Ver.) **Works Technical Department monthly progress report, January 1955.** Du Pont de Nemours (E.I.) and Co., Aiken, SC (United States). Savannah River Plant. 22 Feb 1955. 143p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. Order Number DE93016033. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This monthly progress report details activities of the Works Technical Department during the month of January 1955.

26292 (DPSP–55-1-2-Del.Ver.) **Works Technical Department monthly progress report, February 1955.** Du Pont de Nemours (E.I.) and Co., Aiken, SC (United States). Savannah River Plant. 18 Mar 1955. 162p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. Order Number DE93016032. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This monthly progress report details activities of the Works Technical Department during the month of February 1955.

26293 (DPSP–55-1-4-Del.Ver.) **Works Technical Department monthly progress report, April 1955.** Du Pont de Nemours (E.I.) and Co., Aiken, SC (United States). Savannah River Plant. 18 May 1955. 161p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. Order Number DE93016076. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report details activities of the Works Technical Department during the month of April, 1955.

26294 (DPSP–55-454-1-Del.) **Savannah River Plant history, reactor areas, July 1954–December 1972.** Du Pont de Nemours (E.I.) and Co., Aiken, SC (United States). Savannah River Plant. [1972]. 283p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. (SR/H–533-Del.). Order Number DE93012787. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This volume contains a condensed survey of the yearly activities of the Reactor Areas and the various Plant agencies which contributed to its operation. Only salient features of the areas' operation are reviewed. Emphasis is placed on results obtained and reasons for action taken rather than on process detail.

26295 (DPSP–55-454-3-Del.) **Savannah River Plant history, Raw Materials Area, July 1954–December 1972.** Du Pont de Nemours (E.I.) and Co., Aiken, SC (United States). Savannah River Plant. [1972]. 193p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. (SR/H–534-Del.). Order Number DE93012788. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This volume contains a condensed survey of the yearly activities of the Raw Materials Area and the various Plant agencies which contributed to its operation. Only salient features of the area's operation are reviewed. Emphasis is placed on results obtained and reasons for action taken rather than on process detail. The time period covered is July 1954 through December 1972.

26296 (DPSP–56-1-2-Del.Ver.) **Works Technical Department monthly progress report, February 1956.** Du Pont de Nemours (E.I.) and Co., Aiken, SC (United States). Savannah River Plant. 16 Mar 1956. 195p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. Order Number DE93016038. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This monthly progress report details activities of the Works Technical Department during the month of February 1956.

26297 (DPSP–58-1-6-Del.Ver.) **Works Technical Department monthly progress report, June 1958.** Du Pont de Nemours (E.I.) and Co., Aiken, SC (United States). Savannah River Plant. 18 Jul 1958. 227p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. Order Number DE93016009. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This monthly progress report details activities of the Works Technical Department during the month of June 1958.

26298 (DPSP–63-1-2-Del.Ver.) **Works Technical Department monthly progress report, February 1963.** Du Pont de Nemours (E.I.) and Co., Aiken, SC (United States). Savannah River Plant. 22 Mar 1963. 259p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. Order Number DE93016040. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This monthly progress report details activities of the Works Technical Department during the month of February 1963.

26299 (DPW–3660) **[Travel to Argonne National Laboratory to observe critical experiments]: Trip report, October 23, 1951.** Toops, E.C. Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). 31 Oct 1951. 2p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. (SR/H–466). Order Number DE93011163. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report describes travel to observe and coordinate the progress of Argonne critical experiments. (FL)

26300 (DPW–3668) **[Proposed training on canning at Hanford].** Dickerson, H.A. Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). Explosives Dept. 31 Oct 1951. 2p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. (SR/H–468). Order Number DE93011165. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This memorandum discusses a proposal to send two groups of trainees to Hanford for training in the Canning Area. (FL)

26301 (DPW–4358) **Construction progress at Savannah River concerning reactor parts and line boring at the NYX Unit and plenum, top shield and tube welding concerns at the R Unit.** Elliott, J.F. Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). 16 Jan 1952. 2p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. (SR/H–436). Order Number DE93011130. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This memorandum discusses construction progress at Savannah River concerning reactor parts and line boring at the NYX unit.

26302 (DPW–4477) **Travel to Bendix Aviation Company's plant at Kansas City, Missouri, to observe the machining operations, and associated work for the production of slugs under the uranium experimental program: Trip report.** Hobert, R.H. Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). Explosives Dept. 9 Jan 1952. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. (SR/H–463). Order Number DE93011158. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This memorandum discusses travel to Bendix Aviation company's plant at Kansas City, Missouri which was made for the purpose of observing the machining operations, and associated work, for the production of slugs under the uranium experimental program.

26303 (DUN–5566-1) **Operations Division single pass reactors semiannual summary report, period ending June 30, 1969.** Prudich, T. Douglas United Nuclear, Inc., Richland, WA (United States). 1 Oct 1969. 22p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93012056. Source: OSTI; NTIS (US Sales Only); GPO Dep.

In this semiannual issue the single pass reactor and water plant data are shown for the six-months' period January through June, 1969, (except for C Reactor which is shown for January through April, 1969, because of deactivation at 1610 hours on April 25, 1969) together with data for the three preceding six-months' periods. For comparison purposes the two years of experience will continue to be shown by dropping and adding a six-months' period with each semiannual issue.

26304 (DUN–5566-2) **Operations Division single pass reactors semiannual summary report, period ending December 31, 1969.** Prudich, T. Douglas United Nuclear, Inc., Richland, WA (United States). 11 Feb 1970. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93012057. Source: OSTI; NTIS (US Sales Only); GPO Dep.

In this semiannual issued the single pass reactor and water plant data are shown for the six-months' period July through December, 1969 together with data for the three preceding six-months' periods.

26305 (EGG-M–93067) **RELAP5/MOD2.5 simulation results for the Separate Effects Test experiment series, Phase 1.** Gaeta, M.J. (EG and G Idaho, Inc., Idaho Falls, ID (United States)); Bollinger, J.S.; Dimenna, R.A. EG and G Idaho, Inc., Idaho Falls, ID (United States); Westinghouse Savannah River Co., Aiken, SC (United States). [1993]. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. Order Number DE93013670. Source: OSTI; NTIS; INIS; GPO Dep.

The Separate Effects Test (SET) facility is a one-fourth linear scale model of a portion of a production reactor at the Savannah River Site. The Phase I configuration is prototypical of a one-sixth sector of the moderator tank and a portion of a single pump suction piping (PSP) loop. The purpose of this work was to perform a preliminary investigation into the suitability of the full-scale SRL reactor modeling methodology to the one-fourth linear scale SET facility. The resulting model will also aid in understanding the experimental results produced by the SET experimental test series. Section 2 gives a brief description of the experimental facility. Section 3 describes the code version of RELAP5 used for this work and the SET input model constructed for the simulations. Section 4 describes the results of the model tuning and the single and two-phase simulations. Sections 5 and 6 contain the conclusions and references respectively.

26306 (FEI–2027) **Experimental testing of the Monte Carlo calculations for prompt neutron lifetime dependence on reactivity of a fast reactor with slowing-down reflector.** Daruga, V.K.; Polevoj, V.B. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk (Russian Federation). Fiziko-Ehnergeticheskij Inst. 1989. [11p.] (In Russian). Order Number DE93629735. Source: OSTI; NTIS (US Sales Only); INIS.

The article presents the results of measuring asymptotic decrement of prompt neutron pulse attenuation in a fast breeder reactor with a slowing down reflector (SR FBR) depending on its subcriticality produced in different ways. The calculations are performed by the Monte Carlo method in 26-group approximation relying on the solution of a quasistationary problem of prompt neutron transport. A good agreement of the calculational and experimental data as regards criticality and their significant divergence with subcriticality growth are noted. A conclusion is made on the appropriateness of the calculation of lifetime in SR FBR using a neutron thermalization model. It is shown that the calculation based only on the solution of the conventionally critical problem disagrees with the experimental data several times. 11 refs.; 3 figs.; 1 tab.

26307 (HW–54942) **Status report – Fuel element machining.** Nickolaus, J.W. Hanford Atomic Products Operation, Richland, WA (United States). 12 Feb 1958. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93014279. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report summarizes the design and development work completed since May, 1957; the current status of fuel element matching problems, and the plans for future modifications to improve machining techniques.

26308 (INIS-mf–12758, pp. 7-14) **HERMET: cell neutronic calculation code for MTR (materials testing reactors) fuels.** Villarino, E.A. (Investigacion Aplicada SE (INVAP), San Carlos de Bariloche (Argentina)); Lecot, C.A.; Giust, F.D. Asociacion Argentina de Tecnologia Nuclear, Buenos Aires (Argentina). 1987. [735p.] (In Spanish). (CONF-8711355–: 15. scientific meeting and 4th Latin American meeting and 1st sessions on nuclear power plants, San Carlos de Bariloche (Argentina), 2-6 Nov 1987). In *Proceedings of the fifteenth scientific meeting; fourth Latin American meeting; first sessions on nuclear power plants.* Order Number DE91003052. Source: OSTI; NTIS (US Sales Only); INIS.

The HERMET neutronic calculation code was developed for resolution of systems, at a cell calculation level in one-dimensional plain geometry (MTR), preserving its heterogeneous character with or without reflecting boundary conditions and reducing the cost as regards time and machine-memory. This code also includes the burn-up calculation which may be performed with the critical spectra B0, B1 or the one improved by leakages corresponding to the buckling given by the user. The burn-up scheme may be carried out by a transport equation with intermediate stages without flux reevaluation or by a predictor-corrector scheme. (Author).

26309 (INIS-mf–12758, pp. 552-556) **RA-6 reactor's probabilistic safety evaluation. Identification and selection of starting events.** Kay, J. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina). Gerencia de Seguridad Radiologica y Nuclear); Chiossi, C.; Felizia, E.; Vallerga, H.; Kalejman, G.; Navarro, R.; Caruso, G.J. Asociacion Argentina de Tecnologia Nuclear, Buenos Aires (Argentina). 1987. [735p.] (In Spanish). (CONF-8711355–: 15. scientific meeting and 4th Latin American meeting and 1st sessions on nuclear power plants, San Carlos de Bariloche (Argentina), 2-6 Nov 1987). In *Proceedings of the fifteenth scientific meeting; fourth Latin American meeting; first sessions on nuclear power plants.* Order Number DE91003052. Source: OSTI; NTIS (US Sales Only); INIS.

A summary of the 'Identification and selection of starting events' stage of the previous probabilistic safety evaluation of RA-6 reactor is presented. This evaluation was performed to verify if the safety criteria required for the licensing of RA-6 are met and to promote the diffusion of its meaning and usefulness with educational purposes. At this stage the starting events of RA-6 are determined and the probability that such events occur is calculated. The identification and selection of starting events is performed in two steps: determination of proposed starting events and determination of postulated starting events. The proposed starting events are determined by means of the master logic diagram (MLD) method, while the postulated starting events are obtained by grouping the proposed starting events. The simplifying hypothesis required for the application of MLD to the reactor are also formulated. The probability that the proposed and postulated starting events occur is afterwards calculated, adopting different fault models, in accordance with the nature of events that are considered. Conservative hypothesis on the characteristics of these events and the uncertainty of parameter values of those models are also formulated. The numerical values of the above mentioned probabilities are obtained by giving the parameters suitable values that are extracted from specialized publications. (Author).

26310 (JAERI-M–93-038) **Annual report of the JMTR: The JMTR operation and technical development No. 6 (fiscal 1991).** Japan Atomic Energy Research Inst., Tokyo (Japan). Mar 1993. 140p. (In Japanese). Order Number DE93508344. Source: OSTI; NTIS; INIS.

The JMTR (Japan Materials Testing Reactor) is a 50 MW tank type reactor, cooled and moderated by light water. It started the irradiation service in 1970. The JMTR has been providing high neutron flux in core positions for irradiation testing of reactor materials and fuels, and for radioisotopes production. In fiscal 1991, the JMTR operated of 5.1 cycles as planned. Extensive irradiation tests, including power ramping tests on LWR fuel rods were carried out. Furthermore, the development of new irradiation techniques and post irradiation techniques such as re-instrumentation of a thermocouple to an irradiated fuel rod and tube joint utilized the shape memory alloys were continued. The study for irradiation performance on fusion reactor blanket was started. For the JMTR core conversion to low-enriched uranium (LEU), the safety review was completed by the competent authorities, and the license was issued. The core of the JMTR will be converted to LEU fuels in 1993. (author).

26311 (JINR-R-3-91-512) **The IBR-2 reactor transients due to uncontrolled decreasing of the auxiliary movable reflector velocity.** Popov, A.K. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Neutron Physics. 1991. [6p.] (In Russian). Order Number DE93629736. Source: OSTI; NTIS (US Sales Only); INIS.

The periodic pulsed reactor transients are calculated at decreasing of the auxiliary movable reflector (AMR) velocity by uncontrolled uncoupling of the AMR with the main movable reflector. At once after breaking the intense drop of power pulse energy takes place. Then in several seconds very large power pulse can appear with its energy several times more than the energy before breaking. The calculations confirm that the appearance of the dangerous large power pulses can be avoided if there is emergency safety system, which acts at decreasing of power pulse energy. 2 refs.; 5 figs.; 2 tabs.

26312 (NMP–92-05) **University Loaned Normal Uranium Slug Disposition Study: University survey responses: Predecisional draft.** Becker, G.W. Jr. Westinghouse Savannah River Co., Aiken, SC (United States). 1 Sep 1992. 83p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93009891. Source: OSTI; NTIS; GPO Dep.

During the 1950's and 1960's, the Atomic Energy Commission loaned rejected natural uranium slugs from the Savannah River Site to United States universities for use in subcritical assemblies. Currently, there are sixty-two universities holding 91,798 slugs, containing about 167 metric tons of natural uranium. It was originally planned that the universities would return the material to Fernald when they no longer required it. Fernald has not received slugs since it was shut down in 1988. The Department of Energy's Office of Weapons and Materials Planning requested that the Planning Support Group develop information to assist them in facilitating the return of the unwanted slugs to one or more of their facilities and develop alternatives for the ultimate disposition of this material. This supplemental report to the University Loaned Normal Uranium Slug Disposition Study documents responses to and summarizes the results of a survey of fifty-eight universities. University contacts and survey responses covering loaned slug descriptions, historical information, radiological data, current status, and plans and schedules are documented.

26313 (SR/H–528) **Historical aspects of plant assistance to Hanford Engineer Works.** Acken, M.F.; Peterson, J.H.; Smith, D.M.; Kay, W.C.; Struthers, G.W.; Faris, B.F.; Apple, R.S.; Curtis, R.E.; Wende, C.W.J.; Gast, P.F.; Dahlen, P.A.; Osterloh, R.H.; Woods, W.K.; Schier, R.J.; Smith, E.A. Hanford Engineer Works, Richland, WA (United States). [1946]. 164p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. Order Number DE93012422. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Although start-up conditions for Hanford were defined on the basis of information obtained at the Metallurgical Laboratory (Chicago) and at Clinton Laboratories, it was anticipated that the plant would require technical assistance in revising and standardizing operating procedures and in following the miscellaneous routine and special projects and tests connected with the various stops of the process. The Separations Engineering (200 Technical) Division of the Technical Department was assigned the responsibility of carrying out this plant assistance work in the 200 Areas. Four groups were established to handle this work, three of these to assist in problems arising in the Canyon (221), Concentration (224), and Isolation (231) Buildings and the fourth to deal with problems arising in connection with equipment design and performance in all three buildings. This memorandum reviews the work of the plant assistance groups in the Canyon and Concentration Buildings, from their inception in September 1944 to August 1, 1945.

26314 (SR/H–541) **[Hanford Department histories]: Accounting Department, Part 1.** [Plant histories]. Hanford Engineer Works, Richland, WA (United States). [1946]. 119p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. Order Number DE93013442. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The Accounting Department of the Hanford Engineer Works has been responsible for all accounting and related activities essential to the operation of the plant and of Richland Village. This work has been divided between two primary Divisions: Accounting and Clerical. In common with the practice at other DuPont-operated war plants, the work of the Accounting Division has been that usually handled for commercial plants by the Wilmington Office. This Division also performed certain phases of Construction Division accounting during plant and Village erection. The size and unique character of this project have increased the scope of most of these accounting functions, and have created additional activities not usually encountered (e.g., recruitment advances, Village accounts receivable, etc.). The Clerical Division has been responsible for the time office, purchasing, and the other clerical and related services essential to normal plant operations. This document, Book one, Part one, of the eighteen volume DuPont History reviews the development of the Accounting Department from the start of its work at Hanford (March 1943) to July 1, 1945.

26315 (SR/H–543) **[Project 98-1086, Technical scopes of work, electrical].** [Engineering Department project files]. Du Pont de Nemours (E.I.) and Co., Aiken, SC (United States). Savannah River Plant. [1961]. 118p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. Order Number DE93013444. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document provides an electrical scope of work for procurement and installation of electrical facilities to serve the Heavy Water Components Test Reactor (HWCTR).

26316 (SR/H–544) **[Project 98-1086, Technical scopes of work, Power "H" and "V", February 13, 1959–May 5, 1961].** [Engineering Department project files]. Du Pont de Nemours (E.I.) and Co., Aiken, SC (United States). Savannah River Plant. [1961]. 118p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. Order Number DE93013445. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document provides a scope work covering the Power Section's design responsibilities for the Heavy Water Components Test Reactor (HWCTR).

26317 (SR/H–545) **[Project 98-1086: Technical scopes of work A and C, February 1959–July 1960].** [Engineering Department Project Files]. Du Pont de Nemours (E.I.) and Co., Aiken, SC (United States). Savannah River Plant. [1959]. 94p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. Order Number DE93013446. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document provides the architectural and civil scope of work for the Heavy Water Components Test Reactor (HWCTR) project.

26318 (SR/H–547) **[Project 98-1086, Technical scopes of work, Process, December 12, 1958–June 20, 1960].** [Engineering Department project files]. Du Pont de Nemours (E.I.) and Co., Aiken, SC (United States). Savannah River Plant. [1960]. 190p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. Order Number DE93013448. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This scope of work provides a broad definition of the Heavy Water Components Test Reactor project as a basis for preparation of Specialist scopes of work.

26319 (SR/H–551) **[Project 98-1086, Technical Meetings, May 23, 1958–October 20, 1958].** [Engineering Department Project Files]. Sindler, M.A. Du Pont de Nemours (E.I.) and Co., Aiken, SC (United States). Savannah River Plant. [1958]. 180p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. Order Number DE93014210. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document provides a discussion of Technical meetings of the Savannah River Plant Engineering Department from May 23, 1958 through October 10, 1958.

26320 (SR/H–552) **[Project 98-1086 technical meetings, June 9, 1959–June 25, 1964].** [Engineering Department Project Files]. Du Pont de Nemours (E.I.) and Co., Aiken, SC (United States). Savannah River Plant. [1964]. 364p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. Order Number DE93014211. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document provides details of technical meetings held during the time period of June 9, 1959 through June 24, 1964 on the Heavy Water Component Test Reactor (HWCTR) project.

26321 (SR/H–554) **[Project 98-1086, Technical AED letters, April 13–June 24, 1960].** [Engineering Department project files]. Du Pont de Nemours (E.I.) and Co., Aiken, SC (United States). [1960]. 208p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. Order Number DE93014213. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document provides letters and correspondence concerning the Heavy Water Components Test Reactor (HWCTR) project for the time period of April 13, 1960 through June 24, 1960.

26322 (SR/H–555) **[Project 98-1086, Technical AED letters, June 24–December 28, 1960].** [Engineering Department project files]. Du Pont de Nemours (E.I.) and Co., Aiken, SC (United States). [1960]. 186p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. Order Number DE93014214. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document provides letters and correspondence concerning the Heavy Water Components Test Reactor (HWCTR) project for the time period of June 24, 1960 through December 28, 1960.

26323 (SR/H–556) **[Project 98-1086, Technical AED letters, June 5, 1959–January 8, 1960].** [Engineering Department project files]. Du Pont de Nemours (E.I.) and Co., Aiken, SC (United States). [1960]. 229p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. Order Number DE93014215. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document provides technical letters and correspondence concerning the Heavy Water Components Test Reactor (HWCTR) project from June 5, 1959 through January 8, 1960.

26324 (SR/H–557) **[Project 98-1086, Technical AED letters, January 4–April 18, 1960].** [Engineering Department project files]. Du Pont de Nemours (E.I.) and Co., Aiken, SC (United States). [1960]. 206p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. Order Number DE93014216. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document provides technical letters and correspondence of the E. I. Du Pont De Nemours & Co.. Atomic Energy Division for the Heavy Water Components Test Reactor (HWCTR) project.

26325 (SR/H–558) **Engineering Dept. project 98-1086 - Technical- AED letters 1/2/59–6/4/59.** [Engineering Department Project Files]. Holmes, R.C. Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). Explosives Dept. [1959]. 216p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. Order Number DE93014217. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document provides a compilation of E. I. Du Pont De Nemours and Co.'s Atomic Energy Division technical letters and correspondence during the period of January 2, 1959 through June 4, 1959.

26326 (SR/H–560) **[Project S8-1086: Scopes of work].** [Engineering Department Project Files]. Du Pont de Nemours (E.I.) and Co., Aiken, SC (United States). Savannah River Plant. 20 Jun 1960. 211p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. Order Number DE93014693. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This scope of work describes in detail facilities and equipment for which the Process Group is responsible. It includes process and mechanical equipment in Buildings 770-U, 771-U and machine tools to be provided by Process in Building 704-U. Also listed are over-all service requirements for emergency electric power, water systems and air systems. Drawings, sketches and other process and mechanical data furnished for estimating purposes are listed.

26327 (SR/H–561) **[The Hanford story, Chapter 12].** [Plant Histories]. Hanford Engineer Works, Richland, WA (United States). [1945]. 77p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. Order Number DE93014694. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document, Chapter 12 of "The Hanford Story" provides a discussion of the manpower requirements of the Hanford Project.

26328 (SR/H–562) **[The Hanford story, Chapter 13].** [Plant Histories]. Hanford Engineer Works, Richland, WA (United States). [1945]. 83p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. Order Number DE93014695. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document, Chapter 13 of "The Hanford Story" discusses the production of Uranium 235 and the research, development, and design of the electromagnetic process utilized in this production.

26329 (WHC-SA–1934) **Operator involvement in plant decision making and self-assessment.** Dugwyler, R.L. Westinghouse Hanford Co., Richland, WA (United States). Apr 1993. 27p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (CONF-930538–2: 4. conduct of operations workshop: the key to continued success, Tampa, FL (United States), 4-6 May 1993). Order Number DE93016479. Source: OSTI; NTIS; INIS; GPO Dep.

The Fast Flux Test Facility has a history of innovation that goes beyond mere compliance with DOE Conduct of Operations. This innovation fosters excellence at all levels of daily operations. Consistent operator input into management decision making and self-assessment has helped to produce an Operations staff that is proud and professional. A group of operators drafted the Fast Flux Test Facility Operations Professional Code, which serves as a benchmark for excellence. Operator committees have proposed changes as varied as the twelve hour rotating shift schedule, a streamlined reactor operator qualification program and an improved new hire training process. The changes succeeded because they had widespread operator acceptance. Similar committees have initiated staffing and qualification changes to help Operations cope with transforming the plant from an operating to a standby status. Standing committees such as the Operations Review Team (1985 to 1988) and the Operations Performance Enhancement Committee (1990 to present) have provided operators with an independent review of root causes and corrective actions to events. This occurs both for in-plant and other DOE facility events, through a Lessons Learned Program. The committees have also had "management's ear" regarding suggestions for improving safety, efficiency and operator performance. As the Fast Flux Test Facility goes from an operating plant to a plant in standby, one of the primary changes will be to maintain operator interest in continual improvement. The Operations Performance Enhancement Committee can assist in this pursuit – a pursuit of excellence. The purpose of this paper is to relate the successes of operator involvement at the Fast Flux Test Facility from the viewpoint of an Operations Engineer.

26330 (WSRC-MS–92-518) **RELAP5/MOD3 analysis of a heated channel in downflow.** Dimenna, R.A.; Qureshi, Z.H.; Boman, A.L. Westinghouse Savannah River Co., Aiken, SC (United States). [1993]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-930778–3: 1993 RELAP5 international users meeting, Boston, MA (United States), 6-9 Jul 1993). Order Number DE93013575. Source: OSTI; NTIS; INIS; GPO Dep.

The onset of flow instability (OFI) is a significant phenomenon affecting the determination of a safe operating power limit in the Savannah River Site production reactors. Tests performed at

Columbia University for a single tube with uniform axial and azimuthal heating have been analyzed with RELAP5/NPR, Version 0, a version of RELAP5/MOD3. The tests include water flow rates from 3.2 x 10^{-4} - 2.1 x 10^{-3} m^3/s (5 - 33 gpm), Reynolds numbers from 30,000 - 400,000, and surface heat fluxes from 0 - 3.2 x 10^6 w/m^2 (0 - 1,000,000 Btu/hr- ft^2). Pressure drop versus flow rate curves were mapped for both fixed pressure boundary conditions and fixed flow boundary conditions. RELAP5/MOD3 results showed fair agreement with data for both types of boundary conditions, and good internal consistency between calculations using the two different types of boundary conditions. Under single-phase unheated conditions, the code overpredicted the pressure drop by 22 - 34%. Under single-phase heated conditions, the overprediction increased to as much as 55%. For those tests where two-phase conditions were observed at the channel exit, RELAP5 predicted lower flows than seen in the tests before voiding occurred.

26331 (WSRC-MS–93-182) **Acceptance criteria for reactor coolant pumps and valves.** Gupta, N.K.; Miller, R.F.; Sindelar, R.L. Westinghouse Savannah River Co., Aiken, SC (United States). [1993]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-930702–19: Pressure vessels and piping conference, Denver, CO (United States), 25-29 Jul 1993). Order Number DE93012758. Source: OSTI; NTIS; INIS; GPO Dep.

Each of the six primary coolant loop systems of the Savannah River Site (SRS) production reactors contains one reactor coolant pump, one PUMP suction side motor operated valve, and other smaller valves. The pumps me double suction, double volute, and radially split type pumps. The valves are different size shutoff and control valves rated from ANSI B16.5 construction class 150 to class 300. The reactor coolant system components, also known as the process water system (PWS), are classified as nuclear Safety Class I components. These components were constructed in the 1950's in accordance with the then prevailing industry practices. No uniform construction codes were used for design and analysis of these components. However, no pressure boundary failures or bolting failures have ever been recorded throughout their operating history. Over the years, the in-service inspection (ISI) was limited to visual inspection of the pressure boundaries, and surface and volumetric examination of the pressure retaining bolts. Efforts are now underway to implement ISI requirements similar to the ASME Section XI requirements for pumps and valves. This report discusses the new ISI requirements which also call for volumetric examination of the pump casing and valve body welds.

26332 (WSRC-MS–93-262) **Development of flaw evaluation and acceptance procedures for flaw indications in the cooling water system at the Savannah River Site K Reactor.** Tandon, S. (Westinghouse Electric Corp., Pittsburgh, PA (US)); Bamford, W.H.; Cowfer, C.D.; Ostrowski, R. Westinghouse Savannah River Co., Aiken, SC (United States). [1993]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-930702–45: Pressure vessels and piping conference, Denver, CO (United States), 25-29 Jul 1993). Order Number DE93014731. Source: OSTI; NTIS; GPO Dep.

This paper describes the methodology used in determining the criteria for acceptance of inspection indications in the K-Reactor Cooling Water System at the Savannah River Plant. These criteria have been developed in a manner consistent with the development of similar criteria in the ASME Code Section 11 for commercial light water reactors, but with a realistic treatment of the operating conditions in the cooling water system. The technical basis for the development of these criteria called "Acceptance Standards" is contained in this paper. A second portion of this paper contains the methodology used in the construction of flaw evaluation charts which have been developed for each specific line size in the cooling water system. The charts provide the results of detailed fracture mechanics calculations which have been completed to determine the largest flaw which can be accepted in the cooling water system without repair. These charts are designed for use in conjunction with inservice inspections of the cooling water system, and only require inspection results to determine acceptability.

26333 (WSRC-MS–93-287) **Effect of power on demand surface and flow instability for annular geometry fuel elements with upflow of coolant.** Smith, A.C. (Westinghouse Savannah River Co., Aiken, SC (United States)); Blake, J.E; Childerson, M.T.; Ohrn, T.R.; Privette, R.M. Westinghouse Savannah River Co., Aiken, SC (United States). [1993]. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-930601–19: American Nuclear Society (ANS) annual meeting, San Diego, CA (United States), 20-24 Jun 1993). Order Number DE93013826. Source: OSTI; NTIS; GPO Dep.

Analytical studies of the effects of power on flow instability in parallel channels with upward flow of coolant, have predicted that the Ledinegg flow instability, encountered as flow is decreased for typical operating power levels, would not be experienced at low power levels. For a system in which the flow of coolant is upward, the increased buoyancy enhances flow in the channel, so that as the void increases, the overall pressure loss decreases. Under this condition, flow instability does not occur. Testing was performed to confirm the predicted behavior and to provide data for benchmarking of computer codes used for predicting the performance of reactor fuel elements. The demand curves traced in these tests are part of the multidimensional demand surface for the test apparatus. The basic coordinates of this surface are flow rate, pressure drop and power. A fourth significant independent variable is system pressure, so that the behavior of the system is represented by a family of Δp-flow-power surfaces for each pressure level. This testing confirmed that, at low power levels comparable to decay heat removal power, the buoyancy effects may become dominant so that the demand curve for the fuel assembly turns downward and flow instability will not occur.

26334 (WSRC-RP–91-1148) **Technical bases of the second generation SARIS core model (Task Number: 90-008-0).** Gregory, M.V. Westinghouse Savannah River Co., Aiken, SC (United States). Nov 1991. 27p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93014752. Source: OSTI; NTIS; INIS; GPO Dep.

A methodology has been developed to rigorously derive the constants in the Savannah River Simulator (SARIS) core model from detailed, charge-design, diffusion theory solutions. This methodology is intended to replace the ill-defined, ad hoc iterative process used in the past to generate these constants. Along the development path, three shortcomings of the current core model were identified and corrected. The updated core model with revised constants is termed the second generation core model. In addition, changes in the decay heat and delayed neutron precursor models are also recommended, all in the interest of improving simulator neutronics fidelity.

26335 (WSRC-TR–92-96) **Reactor safety research section probability of heat exchanger leaks.** Cramer, D.S.; Shine, E.P.; Copeland, W.J. Westinghouse Savannah River Co., Aiken, SC (United States). Feb 1992. 40p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93014753. Source: OSTI; NTIS; GPO Dep.

Three heat exchangers (HXs) were changed out after the December 1991 leak of Process Water to the Savannah River. This leaves 6 of the original 304 stainless steel heat exchangers which will remain in K-Reactor for restart. This report discusses SRS site specific data which were used to estimate the probability of a leak within a one-year period as a function of leak rate and root cause in these six heat exchangers in conjunction with six new heat exchangers presently in service in K-Reactor. Based on several assumptions and statistical models, SRS data indicate that the total probability of a leak occurring during a one-year period in K-Reactor with 6 original (304 stainless steel) and 6 new (316-L or SEA-CURE) heat exchangers, with a leak rate greater than 20, 40 or 90 pounds/hr, is 0.013, 0.004 or 0.0005, respectively.

26336 (WSRC-TR–92-439) **Further code validation of Technical Specification Bases.** Apperson, C.E.; Webb, R.L. Westinghouse Savannah River Co., Aiken, SC (United States). Sep 1992. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93014751. Source: OSTI; NTIS; INIS; GPO Dep.

Personnel from the Applied Physics Group (APG) and from the Reactor Technology Section devised the K-14 reactor restart test program. The primary purpose of that program was to acquire data

which could be used to further validate the computer codes which supported the Technical Specification Bases. The test program was highly successful and a large amount of useful data was obtained. DOE has now requested the schedule and plan for the additional code validation activities. A response to DOE was made in which an outline of WSRC's (Westinghouse Savannah River Co.) planned activities was presented, but specifics were not discussed. This memorandum is intended to provide additional details on these activities. The WSRC plan consists of five major activities. The first activity is to catalog and document the measured data. The second activity is to investigate the radial and axial neutron flux distributions. The results from this task will complement the analyses being performed in the final three activities: steady state reactivity effects, transient reactivity effects, and planned an unplanned shutdowns. Work on these activities is scheduled to be completed by the end of the fiscal year 1993.

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Refer also to citation(s) 25880, 25890, 26117, 26128, 26131, 26205, 26239, 26243, 26251, 26253, 26265, 26273, 26335, 27253, 27254, 28157, 28158, 28160

26337 (ANL/NPR–92/6) **Molten fuel fragmentation experiments: Stage 2: New Production Reactors Program.** Gabor, J.D.; Purviance, R.T.; Cassulo, J.C.; Spencer, B.W. Argonne National Lab., IL (United States). Jul 1992. 49p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. Order Number DE93012143. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Severe accident questions for the Heavy Water Reactor – New Production Reactor (HWR-NPR) include the interaction of the water in the lower plenum with the melt relocating from the core. Important concerns in the melt-water interaction are the depth of pour stream penetration, breakup, quenching, hydrogen generation, and characteristics of the pour stream fragments. The goal of the current experiments discussed in this report was to identify the controlling breakup mechanisms of the flowing pour stream of aluminum alloy melt in water. The fragment size and condition (solidified or molten) can be modeled in analysis of coolability from an understanding of the breakup mechanics. The extent of fragmentation affects other phenomena; i.e., heat transfer, chemical reactions and potential for energetic steam explosions. Therefore various parameters such as alloy composition, water temperature, pour stream velocity, and pour stream geometry resulting from NPR-HWR design considerations which would affect these phenomena were investigated.

26338 (ANL/NPR–92/7) **Fuel/target relocation experiments: New Production Reactors Program.** Spencer, B.W.; Sienicki, J.J.; Gunther, W.H.; Cassulo, J.C. Argonne National Lab., IL (United States). Sep 1992. 160p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. Order Number DE93013052. Source: OSTI; NTIS (US Sales Only); GPO Dep.

A series of eleven tests were performed to address the melting, relocation, and channel plugging behavior of surrogate aluminum fuel and target material in essentially full scale elemental subchannel geometry. These tests were based on conditions in a loss of coolant accident (LOCA), with scram, in the reference reactor system which was the Ebasco-design 2500 MWt HWR-NPR and Mark 22I-3 reference fuel assembly design. Test conditions involving channel wall melting ignored the expected functioning of reactor safety features and the exceedingly small probability of an accident progressing to the point of fuel melting. The topic of fuel/target separation during fuel tube melting (by downward draining of melting fuel leaving standing intact, colder target tubes) is a key safety issue for HWR-NPR, because sequence calculations indicate a resulting reactivity transient. This experimental study was planned to focus on fuel melting behavior, especially with respect to involvement of the targets, as a database for modeling in the RELOCATE detailed model and the SAS-HWR integrated accident analysis code.

26339 (ANL/NPR–92/16) **Modeling and analysis of melt pool heat transfer and vessel bottom head dissolution: New Production Reactors Program.** Tan, M.J. (Argonne National Lab., IL (United States)); Cho, D.H.; Cheung, F.B. Argonne National Lab., IL (United States). Sep 1992. 69p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. Order Number DE93010995. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Under conditions of failure of the emergency core cooling system in a heavy water production reactor, core meltdown may occur and molten fuel may come into contact with the bottom head of the reactor vessel. A computer code, ACCORD, that features the use of a directional effective thermal conductivity in modeling natural convection in heat-generating liquid pools and the use of a mass transfer coefficient in modeling dissolution of the interior surface of a reactor bottom head into a melt pool has been developed to track the thermal behavior of a melt pool formed inside the bottom head of a reactor vessel and to study the interactions between the melt pool and the bottom head. The discretization scheme for the melt pool is designed specifically for liquid pools bounded from below by curved surfaces. Heat transfer in the melt pool is treated as axisymmetric and twodimensional while that in the bottom head is treated as locally one-dimensional. The temperature distributions in the melt pool and in the bottom head are solved sequentially instead of simultaneously and are coupled through boundary conditions at the interface between the melt pool and the bottom head. The basic equations and their solution method for the ACCORD code are described. The capability of the code is illustrated with calculations using parameters pertaining to the reactor vessel in the original EBASCO full-size-plant design.

26340 (ANL/NPR–93/3) **Estimation of long period ground motions for use in analysis of base-isolated structures: New Production Reactors Program.** Abrahamson, N.A. (Woodward-Clyde Consultants, Pasadena, CA (United States)). Argonne National Lab., IL (United States); Woodward-Clyde Consultants, Pasadena, CA (United States). Sep 1990. 29p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. Order Number DE93010894. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Typically, engineering seismology has been concerned with high frequency ground motions. High frequency motions are very complex and are often assumed to be stochastic. Physically, high frequency ground motions are generated by the acceleration or deceleration of the rupture front and by variations in the amount of slip along the fault. The propagation of high frequency waves (including scattering) is affected by the small scale heterogeneities in the crust. Therefore, the high frequency ground motions are sensitive to the fine details of the source process as well as the fine details of the geologic structure. As a result, ground motion simulations using theoretical models based on gross models of the source process and geologic structure do not reliably predict high frequency motions. Successful simulations of high frequency ground motions use stochastic, empirical or semi-empirical models. This report discusses seismic base isolation which is a design method that shifts the response of a structure from high frequencies to moderate or low frequencies depending on the type of isolator used. This shift reduces the effect of the peak acceleration on the structure, but increases the effect of the peak velocity and peak displacements. Therefore, for base-isolated structures, the concern is with the long period ground motions.

26341 (ANL/NPR–93/6) **The foaming of U-Al fuel under simulated reactor accident conditions: New Production Reactors Program.** Neimark, L.A.; Liu, Y.Y. Argonne National Lab., IL (United States). Mar 1993. 27p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. Order Number DE93012377. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report discusses postirradiation heating tests which were conducted on segments of UAl_4-Al dispersion fuel plates clad with Al to scope the foaming behavior of such fuels during beyond-design-basis accident scenarios. Four tests investigated maximum temperature, ramp rate, and duration with a liquid phase as parameters in foam formation and stability, Real-time fission-gas release was also determined during the foaming process. Ramp-rate had the most noticeable effect on foam formation and collapse.

26342 (BNL–48697) **Status of nuclear safety R&D in the US.** Bari, R.A. Brookhaven National Lab., Upton, NY (United States). [1993]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-9304123–1: 8. Korean Atomic Industrial Forum/Korean Nuclear Society/OKAEA annual conference, Seoul (Korea, Republic of), 20-21 Apr 1993). Order Number DE93012523. Source: OSTI; NTIS; INIS; GPO Dep.

The status of nuclear safety research and development in the US is presented with particular emphasis on work performed by Brookhaven National Laboratory. The nuclear safety program in the US encompasses safety of the current generation of operating commercial reactors, safety-related design of the next generation of advanced reactors, and safety activities for the reactors owned by the US Department of Energy. The broad topical areas of safety research include (but are not limited to) severe accidents, reliability/risk assessment, human performance, thermal-hydraulics, plant aging, seismic, and structural studies.

26343 (BNL-NUREG–47879) **Analysis of accidents during the mid-loop operating state at a PWR.** Jo, J.; Lin, C.C.; Mufayi, V.; Neymotin, L.; Nimnual, S. Brookhaven National Lab., Upton, NY (United States). [1992]. 13p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-921007–25: 20. water reactor safety information meeting, Bethesda, MD (United States), 21-23 Oct 1992). Order Number DE93013342. Source: OSTI; NTIS; INIS; GPO Dep.

Studies suggest that the risk of severe accidents during low power operation and/or shutdown conditions could be a significant fraction of the risk at full power operation. The Nuclear Regulatory Commission has begun two risk studies to evaluate the progression of severe accidents during these conditions: one for the Surry plant, a pressurized water reactor (PWR), and the other for the Grand Gulf plant, a boiling water reactor (BWR). This paper summarizes the approach taken for the Level 2/3 analysis at Surry for one plant operating state (POS) during shutdown. The current efforts are focussed on evaluating the risk when the reactor is at mid-loop; this particular POS was selected because of the reduced water inventory and the possible isolation of the loops. The Level 2/3 analyses are conditional on core damage having occurred. Initial results indicate that the conditional consequences can indeed be significant; the defense-in-depth philosophy governing the safety of nuclear power plants is to some extent circumvented because the containment provides only a vapor barrier with no capability for pressure holding, during this POS at Surry. However, the natural decay of the radionuclide inventory provides some mitigation. There are essentially no predicted offsite prompt fatalities even for the most severe releases.

26344 (BNL-NUREG–48657) **Human Factors Engineering Review Model for advanced nuclear power reactors.** O'Hara, J. (Brookhaven National Lab., Upton, NY (United States)); Higgins, J.; Goodman, C.; Galletti, G.: Eckenrode, R. Brookhaven National Lab., Upton, NY (United States). [1993]. 6p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-930401–17: Meeting on nuclear plant instrumentation, control and man-machine interface technologies, Oak Ridge, TN (United States), 18-21 Apr 1993). Order Number DE93012525. Source: OSTI; NTIS; INIS; GPO Dep.

One of the major issues to emerge from the initial design reviews under the certification process was that detailed human-systems interface (HSI) design information was not available for staff review. To address the lack of design detail issue. The Nuclear Regulatory Commission (NRC) is performing the design certification reviews based on a design process plan which describes the human factors engineering (HFE) program elements that are necessary and sufficient to develop an acceptable detailed design specification. Since the review of a design process is unprecedented in the nuclear industry. The criteria for review are not addressed by current regulations or guidance documents and. therefore, had to be developed. Thus, an HFE Program Review Model was developed. This paper will describe the model's rationale, scope, objectives, development, general characteristics. and application.

26345 (BNL-NUREG–48890) **Aging assessments: A strategy for today and the future.** Lofaro, R.; Taylor, J. Brookhaven National Lab., Upton, NY (United States). [1993]. 7p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-930807–1: 16. biennial conference on reactor operating experience, Upton, NY (United States), 16-18 Aug 1993). Order Number DE93014302. Source: OSTI; NTIS; INIS; GPO Dep.

Aging assessments have been performed for selected nuclear power plant systems under the NRC's Nuclear Plant Aging Research (NPAR) program. These assessments are typically performed by evaluating industry wide data from national databases. The results provide useful information on the typical aging characteristics for the system studied. However, due to the differences in operation and environmental conditions, as well as maintenance practices between plants, the results of the industry wide data analyses may not be representative of specific plant conditions. Therefore, it would be beneficial for utilities to perform their own plant specific aging assessments. This paper discusses an approach that can be used by the utilities to perform an aging assessment of their plant systems. The methodology is based on that used to perform the NPAR system studies at Brookhaven National Laboratory. The reasons for performing a plant specific system level aging assessment are discussed, along with the sources of information that should be used. In addition, a methodology for performing the assessment is presented. Sample charts and tables are included to illustrate the expected products. A discussion is included on what to look for in the available data, how to interpret the findings, and how to implement the results.

26346 (CEA-DES–115) **Reactivity accidents of Super Phenix and EFR reactors.** Natta, M. (CEA Centre d'Etudes de Fontenay-aux-Roses, 92 (France). Dept. d'Evaluation de Surete); Lauret, P.; Moreau, J. CEA Centre d'Etudes de Fontenay-aux-Roses, 92 (France). Dept. d'Evaluation de Surete. Mar 1993. [22p.] (In French). (CONF-9209365–: Conference on reactivity accidents of nuclear reactors, Kiev (Russian Federation), 28 Sep - 3 oct 1992). Order Number DE93631525. Source: OSTI; NTIS (US Sales Only); INIS.

In this presentation of reactivity accidents on Super Phenix and EFR project we look first the causes of reactivity insertions and the precautions taken to evade these accidents, then the scenario of the envelope of accidents consequences giving a core fusion and defining the containment.

26347 (CONF-921007–30) **Auxiliary feedwater system aging study.** Kueck, J.D. Oak Ridge National Lab., TN (United States). [1992]. 12p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC05-84OR21400. From 20. water reactor safety information meeting; Bethesda, MD (United States); 21-23 Oct 1992. Order Number DE93015187. Source: OSTI; NTIS; INIS; GPO Dep.

The Phase 1 Auxiliary Feedwater (AFW) System Aging Study, NUREG/CR-5404 V1, focused on how and to what extent the various AFW system component types fail, how the failures have been and can be detected, and on the value of current testing requirements and practices. This follow-on study, which will be provided in full in NUREG/CR-5404 V2, provides a closure to the Phase 1 Study. For each of the component types and for the various sources of component failure identified in the Phase 1 Study, the methods of failure detection were designated and tabulated and the following findings became evident: Instrumentation and Control (I and C) related failures dominated the group of failures that were detected during demand conditions; many of the potential failure sources not detectable by the current monitoring practices were related to the I and C portion of the system; some component failure modes are actually aggravated by conventional test methods; and several important system functions did not undergo any function verification test. The goal of this follow-on study was to categorize and evaluate the deficiencies in testing identified by Phase 1 and to make specific recommendations for corrective action. In addition, this study presents discussions of alternate, state-of-the-art test methods, and provides a proposed Auxiliary Feedwater Pump test at normal operating pressure which should do much to verify system operability while eliminating degradation.

26348 (CONF-921007–31) **Identification and assessment of BWR in-vessel severe accident mitigation strategies.** Hodge, S.A.; Kress, T.S.; Cleveland, J.C.; Petek, M. Oak Ridge National

Lab., TN (United States). [1992]. 19p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC05-84OR21400. From 20. water reactor safety information meeting; Bethesda, MD (United States); 21-23 Oct 1992. Order Number DE93015520. Source: OSTI; NTIS; INIS; GPO Dep.

This paper briefly describes the results of work carried out in support of the US Nuclear Regulatory Commission Accident Management Research Program to evaluate the effectiveness and feasibility of current and proposed strategies for BWR severe accident management. These results are described in detail in the just-released report Identification and Assessment of BWR In-Vessel Severe Accident Mitigation Strategies, NUREG/CR-5869, which comprises three categories of findings. First, an assessment of the current status of accident management strategies for the mitigation of in-vessel events for BWR severe accident sequences is combined with a review of the BWR Owners' Group Emergency Procedure Guidelines (EPGs) to determine the extent to which they currently address the characteristic events of an unmitigated severe accident. Second, where considered necessary, new candidate accident management strategies are proposed for mitigation of the late-phase (after core damage has occurred) events. Finally, two of the four candidate strategies identified by this effort are assessed in detail. These are (1) preparation of a boron solution for reactor vessel refill should control blade damage occur during a period of temporary core dryout and (2) containment flooding to maintain the core debris within the reactor vessel if the injection systems cannot be restored.

26349 (DOE/FTR–93011934) **[INEL factfinding mission to Russia, Ukraine, and eastern Europe regarding nuclear safety]: Foreign trip report, February 1–19, 1993.** Bickel, J.H.; Modro, S.M. EG and G Idaho, Inc., Idaho Falls, ID (United States). 1993. 42p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. Order Number DE93011934. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report discusses travel to Russia, Ukraine, and Eastern Europe regarding nuclear safety. In order to obtain better information regarding nuclear safety technical assistance needs in these countries. A series of technical meetings were arranged between the INEL and various organizations in these countries. The trip was partially funded by the IAEA Division of Nuclear Safety (Bickel at VNIIAES) and from internal INEL funds.

26350 (EGG-GEO–10304-Vol.1) **Earthquake ground motion evaluations for the proposed new production reactor at the Idaho National Engineering Laboratory: Volume 1, Deterministic evaluation.** Wong, I. (Woodward-Clyde Consultants, Oakland, CA (United States)); Hemphill-Haley, M.; Sawyer, T.; Youngs, R.; Makdisi, F.; Wells, D.; Coppersmith, K.; Stark, C.; Castro, R.; Chiou, S.; Silva, W.; Bruhn, R.; Daning, Wu.; Kneupfer, P. EG and G Idaho, Inc., Idaho Falls, ID (United States); Woodward-Clyde Consultants, Oakland, CA (United States); Geomatrix Consultants, Inc., San Francisco, CA (United States); Pacific Engineering and Analysis, Inc., El Cerrito, CA (United States). Jun 1992. 298p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. Order Number DE93012164. Source: OSTI; NTIS (US Sales Only); GPO Dep.

At the request of EG&G Idaho, Inc. and the Department of Energy, this Volume I report describes and summarizes a deterministic earthquake ground motion evaluation for the proposed New Production Reactor (NPR) at the Idaho National Engineering Laboratory (INEL). The purpose of this evaluation is to provide input into a proposed INEL-NPR Integrated Safety Analysis Report (ISAR) as specified in US Nuclear Regulatory Commission (US-NRC) Regulatory Guide 1.70 for Section 2.5.2 "Vibratory Ground Motion." It should be noted, however, that the intent of the deterministic studies is to address only the most significant earthquake sources relevant to the NPR site rather than all potential seismic sources within 200 miles as required in Regulatory Guide 1.70. It is recognized that other earthquake sources may pose a hazard to the INEL such as the Lost River fault, source of the 1983 moment magnitude (M_w) 6.8 Borah Peak earthquake.

26351 (EGG-M–92638) **Probabilistic based design rules for intersystem LOCAS in ABWR piping.** Ware, A.G. (EG and G Idaho, Inc., Idaho Falls, ID (United States)); Wesley, D.A. EG and G Idaho, Inc., Idaho Falls, ID (United States); EQE Engineering Consultants, Irvine, CA (United States). [1993]. 16p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC07-76ID01570. (CONF-930702–23: Pressure vessels and piping conference, Denver, CO (United States), 25-29 Jul 1993). Order Number DE93013673. Source: OSTI; NTIS; INIS; GPO Dep.

A methodology has been developed for probability-based standards for low-pressure piping systems that are attached to the reactor coolant loops of advanced light water reactors (ALWRs) which could experience reactor coolant loop temperatures and pressures because of multiple isolation valve failures. This accident condition is called an intersystem loss-of-coolant accident (IS-LOCA). The methodology was applied to various sizes of carbon and stainless steel piping designed to advanced boiling water reactor (ABWR) temperatures and pressures.

26352 (EGG-M–93032) **The NUCLARR databank: Human reliability and hardware failure data for the nuclear power industry.** Reece, W.J. EG and G Idaho, Inc., Idaho Falls, ID (United States). [1993]. 6p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC07-76ID01570. (CONF-930243–7: Data banks for risk assessment workshop, Augusta, GA (United States), 2-3 Feb 1993). Order Number DE93013674. Source: OSTI; NTIS; INIS; GPO Dep.

Under the sponsorship of the US Nuclear Regulatory Commission (NRC), the Nuclear Computerized Library for Assessing Reactor Reliability (NUCLARR) was developed to provide human reliability and hardware failure data to analysts in the nuclear power industry. This IBM-compatible databank is contained on a set of floppy diskettes which include data files and a menu-driven system for locating, reviewing, sorting, and retrieving the data. NUCLARR contains over 2500 individual data records, drawn from more, than 60 sources. The system is upgraded annually, to include additional human error and hardware component failure data and programming enhancements (i.e., increased user-friendliness). NUCLARR is available from the NRC through project staff at the INEL.

26353 (EGG-M–93123) **Interpretation of risk significance of passive component aging using probabilistic structural analysis.** Phillips, J.H. (TENERA, L.P., Idaho Falls, ID (United States)); Atwood, C.L. EG and G Idaho, Inc., Idaho Falls, ID (United States). [1993]. 10p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC07-76ID01570. (CONF-930702–22: Pressure vessels and piping conference, Denver, CO (United States), 25-29 Jul 1993). Order Number DE93013664. Source: OSTI; NTIS; INIS; GPO Dep.

The probabilistic risk assessments (PRAs) being developed at most nuclear power plants to calculate the risk of core damage generally focus on the possible failure of active components. Except as initiating events, the possible failure of passive components is given little consideration. The NRC is sponsoring a project at INEL to investigate the risk significance of passive components as they age. For this project, we developed a technique to calculate the failure probability of passive components over time, and demonstrated the technique by applying it to a weld in the auxiliary feedwater (AFW) system. A decreasing yearly rupture rate for this weld was calculated instead of the increasing rupture rate trend one might expect. We attribute this result to infant mortality; that is, most of those initial flaws that will eventually lead to rupture will do so early in life. This means that although each weld in a population may be wearing out, the population as a whole can exhibit a decreasing rupture rate. This observation has implications for passive components in commercial nuclear plants and other facilities where aging is a concern. For the population of passive components that exhibit a decreasing failure rate, risk increase is not a concern. The next step of the work is to identify the attributes that contribute to this decreasing rate, and to determine any attributes that would contribute to an increasing failure rate and thus to an increased risk.

26354 (EGG-NERD–8648) **Probability of the iodine spike release rate during an SGTR.** Adams, J.P.; Atwood, C.L. EG and G Idaho, Inc., Idaho Falls, ID (United States). Sep 1989. 70p. Sponsored by Nuclear Regulatory Commission, Washington, DC

(United States). DOE Contract AC07-76ID01570. Order Number DE93017396. Source: OSTI; NTIS; INIS; GPO Dep.

The Nuclear Regulatory Commission (NRC) requires utilities to determine the response of a pressurized water reactor (PWR) to a steam generator tube rupture (SGTR) as part of the safety analysis for the plant. The SGTR analysis includes assumptions regarding the presence of fission product iodine in the reactor coolant resulting from iodine spikes. Due to uncertainties in the consequences, the NRC has designated this class of accident as a generic safety issue. To get a better understanding of iodine spiking, reactor trip and associated radiochemistry data were collected from 26 PWRs. These data were compared against validation criteria to determine their applicability to an investigation of the magnitude of an iodine spike following a reactor trip. The applicable data and the results of a statistical analysis are presented. Conclusions are made concerning the magnitude of an iodine spike during an SGTR and these are compared with the NRC analysis criteria. The conclusion is made that the iodine release rate specified for analysis of an SGTR is overly conservative and could be reduced significantly while still maintaining adequate protection to the public. The formalism required by the Standard Review Plan in determining the release rate is judged to be inappropriate and an absolute release rate, based on plant electric power, is recommended as a replacement. A value of 0.710 Ci/h*MW(e) is recommended for consideration as a replacement for the current iodine release rate specification for an SGTR with coincident iodine spike.

26355 (EGG-RTAP–10627) **Technical evaluation report, TMI action NUREG-0737 (II.D.1), relief and safety valve testing, Comanche Peak, Unit 2, Docket No. 50-446.** Fineman, C.P. EG and G Idaho, Inc., Idaho Falls, ID (United States). Jan 1993. 35p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC07-76ID01570. Source: OSTI; NTIS; INIS.

In the past, safety and relief valves installed in the primary coolant system of light water reactors have performed improperly. As a result, the authors of NUREG-0578 (TMI-2 Lessons Learned Task Force Status Report and Short-Term Recommendations) and, subsequently, NUREG-0737 (Clarification of TMI Action Plan Requirements) recommended development and completion of programs to do two things. First, the programs should reevaluate the functional performance capabilities of pressurized water reactor safety, relief, and block valves. Second, they should verify the integrity of the pressurizer safety and relief valve piping systems for normal, transient, and accident conditions. This report documents the review of those programs by EG&G Idaho, Inc. Specifically, this report documents the review of the Comanche Peak, Unit 2, Applicant response to the requirements of NUREG-0578 and NUREG-0737. This review found the Applicant provided an acceptable response reconfirming they met General Design Criteria 14, 15, and 30 of Appendix A to 10 CFR 50 for the subject equipment.

26356 (INIS-mf–12758, pp. 120-124) **Statistical inference of the nuclear accidents occurrence number for the next decade.** Felizia, E.R. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina). Gerencia de Seguridad Radiologica y Nuclear). Asociacion Argentina de Tecnologia Nuclear, Buenos Aires (Argentina). 1987. [735p.] (In Spanish). (CONF-8711355–: 15. scientific meeting and 4th Latin American meeting and 1st sessions on nuclear power plants, San Carlos de Bariloche (Argentina), 2-6 Nov 1987). In *Proceedings of the fifteenth scientific meeting; fourth Latin American meeting; first sessions on nuclear power plants.* Order Number DE91003052. Source: OSTI; NTIS (US Sales Only); INIS.

This paper aims to give a response using the classical statistical and bayesian inference techniques regarding the common characteristic in the Harrisburg and Chernobyl nuclear accidents: in both reactors, core fusion occurred. In relation to the last mentioned techniques, the most recent developments were applied, based on the decision theory of uncertainty; among others, the principle of maximum entropy. Besides, as a preliminar information on the accidents occurrence frequency with core fusion, the German risk analysis results were used. The estimations predicted for the next decade an average between one or two accidents with core fusion and low possibilities for the 'no accident' event in the same period. (Author).

26357 (JAERI-M–93-027) **Implementation of JAERI's reflood model into TRAC-PF1/MOD1 code.** Akimoto, Hajime (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment); Ohnuki, Akira; Murao, Yoshio. Japan Atomic Energy Research Inst., Tokyo (Japan). Feb 1993. 72p. (In Japanese). Order Number DE93508318. Source: OSTI; NTIS; INIS.

Selected physical models of REFLA code, that is a reflood analysis code developed at JAERI, were implemented into the TRAC-PF1/MOD1 code in order to improve the predictive capability of the TRAC-PF1/MOD1 code for the core thermal hydraulic behaviors during the reflood phase in a PWR LOCA. Through comparisons of physical models between both codes, (1) Murao-Iguchi void fraction correlation, (2) the drag coefficient correlation acting to drops, (3) the correlation for wall heat transfer coefficient in the film boiling regime, (4) the quench velocity correlation and (5) heat transfer correlations for the dispersed flow regime were selected from the REFLA code to be implemented into the TRAC-PF1/MOD1 code. A method for the transformation of the void fraction correlation to the equivalent interfacial friction model was developed and the effect of the transformation method on the stability of the solution was discussed. Through assessment calculation using data from CCTF (Cylindrical Core Test Facility) flat power test, it was confirmed that the predictive capability of the TRAC code for the core thermal hydraulic behaviors during the reflood can be improved by the implementation of selected physical models of the REFLA code. Several user guidelines for the modified TRAC code were proposed based on the sensitivity studies on fluid cell number in the hydraulic calculation and on node number and effect of axial heat conduction in the heat conduction calculation of fuel rod. (author).

26358 (JAERI-M–93-045) **Assessment of TRAC-BF1 1D reflood model with CCTF and SCTF data.** Akimoto, Hajime (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment); Ohnuki, Akira; Murao, Yoshio; Abe, Yutaka. Japan Atomic Energy Research Inst., Tokyo (Japan). Mar 1993. 137p. Order Number DE93508320. Source: OSTI; NTIS; INIS.

Post test calculations for six selected Cylindrical Core Test Facility (CCTF) and Slab Core Test Facility (SCTF) tests were performed to assess the core thermal hydraulic models of the TRAC-BF1 code during the reflood in a PWR LOCA. A special version of the TRAC code was developed at JAERI by implementing the constitutive package of the TRAC-BF1 code into the TRAC-PF1 code for this assessment. The TRAC-BF1 model predicted well the void fraction at either bottom or top part of the core and overpredicted the void fraction at the center part of the core in the CCTF and SCTF tests performed under so-called licensing conditions. The TRAC-BF1 model overpredicted the clad temperatures at the center part of the core. The TRAC-BF1 model predicted a jump of void fraction where the flow pattern transition between the bubbly/slug flow and the annular/dispersed flow regimes occurred. The jump caused the water mass flow rate to be unstable and resulted in the overprediction of the void fraction at the center part of the core. It was also found that the TRAC-BF1 film boiling model underestimated the heat transfer coefficient in the vicinity of the quench front and caused the quench front propagation to be delayed. These assessment results suggest the following areas should be improved in future to apply the TRAC-BF1 code to the reflood in a PWR LOCA: (1) Core hydraulic model where flow pattern transition occurs, (2) Core heat transfer model in the film boiling regime, especially for the dependence on the distance from the quench front. (author).

26359 (LA-UR–93-807) **Recent developments in the TWODANT system of codes for criticality safety.** Parsons, D.K.; Alcouffe, R.E.; Marr, D.R.; Brinkley, F.W. Los Alamos National Lab., NM (United States). [1993]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930907–2: ANS topical meeting on physics and methods in criticality safety, Nashville, TN (United States), 19-23 Sep 1993). Order Number DE93010716. Source: OSTI; NTIS; GPO Dep.

The application of deterministic, discrete ordinates codes to criticality safety problems can be a very useful complement to analyses performed using Monte Carlo methods. This is especially so if there is a need for dose or flux maps of the system or if

configuration perturbations are to be studied. In these latter two situations, it is difficult to obtain reliable Monte Carlo results due to statistical effects. Deterministic calculations are also useful as an independent check and verification of Monte Carlo results. The TWODANT system of discrete ordinates codes' has recently been enhanced for criticality safety analysis. In addition to ONEDANT, TWODANT, and TWOHEX, the TWODANT system now includes TWODANT/GQ and THREEDANT. These two new code modules expand the applicability of the TWODANT system. These new capabilities will be demonstrated on a representative sample of nuclear criticality safety problems. First, TWODANT/GQ and THREEDANT will be described. Salient features of each code module will be discussed. Calculational results obtained by each will be presented and compared with each other and with Monte Carlo results. Finally, some guidelines for the effective use of the TWODANT system on criticality applications will be given.

26360 (NUREG/CR–5305-Vol.2-Pt.1) **Integrated Risk Assessment for the LaSalle Unit 2 Nuclear Power Plant: Phenomenology and Risk Uncertainty Evaluation Program (PRUEP): Appendices A–C: Volume 2, Part 1.** Brown, T.D. (Sandia National Labs., Albuquerque, NM (United States)); Payne, A.C. Jr.; Miller, L.A.; Shiver, A.W.; Higgins, S.J.; Sype, T.T.; Johnson, J.D.; Chanin, D.I. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Safety Issue Resolution; Sandia National Labs., Albuquerque, NM (United States). May 1993. 476p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC04-76DP00789. (SAND–90-2765-Vol.2-Pt.1). Source: OSTI; NTIS; INIS; GPO.

This volume contains a description of the codes and input/output files used to perform the LaSalle Level II/III Probabilistic Risk Assessment. A chart showing the process flow is presented and the relationship between the codes and the needed input and output data is discussed. Code listings for codes not documented elsewhere and complete or sample listings of the input and output files are also presented.

26361 (NUREG/CR–5305-Vol.2-Pt.2) **Integrated Risk Assessment for the LaSalle Unit 2 Nuclear Power Plant: Phenomenology and Risk Uncertainty Evaluation Program (PRUEP): Volume 2, Part 2, Appendices D-G.** Brown, T.D. (Sandia National Labs., Albuquerque, NM (United States)); Payne, A.C. Jr.; Miller, L.A.; Shiver, A.W.; Higgins, S.J.; Sype, T.T.; Johnson, J.D.; Chanin, D.I. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Safety Issue Resolution; Sandia National Labs., Albuquerque, NM (United States). May 1993. 470p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC04-76DP00789. (SAND–90-2765-Vol.2-Pt.2). Source: OSTI; NTIS; INIS; GPO.

This volume contains a description of the codes and input/out files used to perform the LaSalle Level II/III Probabilistic Risk Assessment. A chart showing the process flow is presented and the relationship between the codes and the needed input and output data is discussed. Code listings for codes not documented elsewhere and complete or sample listings of the input and output files are also presented.

26362 (NUREG/CR–5759) **Risk analysis of highly combustible gas storage, supply, and distribution systems in PWR plants.** Simion, G.P. (Science Applications International Corp., Albuquerque, NM (United States)); VanHorn, R.L.; Smith, C.L.; Bickel, J.H.; Sattison, M.B.; Bulmahn, K.D. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Safety Issue Resolution; EG and G Idaho, Inc., Idaho Falls, ID (United States). Jun 1993. 220p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC07-76ID01570. (EGG–2640). Source: OSTI; NTIS; INIS; GPO.

This report presents the evaluation of the potential safety concerns for pressurized water reactors (PWRs) identified in Generic Safety Issue 106, Piping and the Use of Highly Combustible Gases in Vital Areas. A Westinghouse four-loop PWR plant was analyzed for the risk due to the use of combustible gases (predominantly hydrogen) within the plant. The analysis evaluated an actual hydrogen distribution configuration and conducted several sensitivity studies to determine the potential variability among PWRs. The sensitivity studies were based on hydrogen and safety-related equipment configurations observed at other PWRs within the United States. Several options for improving the hydrogen distribution system design were identified and evaluated for their effect on risk and core damage frequency. A cost/benefit analysis was performed to determine whether alternatives considered were justifiable based on the safety improvement and economics of each possible improvement.

26363 (NUREG/CR–5966) **A simplified model of aerosol removal by containment sprays.** Powers, D.A. (Sandia National Labs., Albuquerque, NM (US)); Burson, S.B. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Safety Issue Resolution; Sandia National Labs., Albuquerque, NM (United States). Jun 1993. 318p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC04-76DP00789. (SAND–92-2689). Source: OSTI; NTIS; INIS; GPO.

Spray systems in nuclear reactor containments are described. The scrubbing of aerosols from containment atmospheres by spray droplets is discussed. Uncertainties are identified in the prediction of spray performance when the sprays are used as a means for decontaminating containment atmospheres. A mechanistic model based on current knowledge of the physical phenomena involved in spray performance is developed. With this model, a quantitative uncertainty analysis of spray performance is conducted using a Monte Carlo method to sample 20 uncertain quantities related to phenomena of spray droplet behavior as well as the initial and boundary conditions expected to be associated with severe reactor accidents. Results of the uncertainty analysis are used to construct simplified expressions for spray decontamination coefficients. Two variables that affect aerosol capture by water droplets are not treated as uncertain; they are (1) 'Q', spray water flux into the containment, and (2) 'H', the total fall distance of spray droplets. The choice of values of these variables is left to the user since they are plant and accident specific. Also, they can usually be ascertained with some degree of certainty. The spray decontamination coefficients are found to be sufficiently dependent on the extent of decontamination that the fraction of the initial aerosol remaining in the atmosphere, m_f, is explicitly treated in the simplified expressions. The simplified expressions for the spray decontamination coefficient are given. Parametric values for these expressions are found for median, 10 percentile, and 90 percentile values in the uncertainty distribution for the spray decontamination coefficient. Examples are given to illustrate the utility of the simplified expressions to predict spray decontamination of an aerosol-laden atmosphere.

26364 (NUREG/CR–5983) **Safety aspects of forced flow cooldown transients in Modular High Temperature Gas-Cooled Reactors.** Kroger, P.G. (Brookhaven National Lab., Upton, NY (United States)). Nuclear Regulatory Commission, Washington, DC (United States). Div. of Systems Research; Brookhaven National Lab., Upton, NY (United States). May 1993. 14p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC02-76CH00016. (BNL-NUREG–52355). Source: OSTI; NTIS; INIS; GPO.

During some of the design basis accidents in Modular High Temperature Gas Cooled Reactors (MHTGRs), the main Heat Transport System (HTS) and the Shutdown Cooling System n removed by the passive Reactor (SCS) are assumed to have failed. Decay heat is the Cavity Cooling System (RCCS) only. If either forced flow cooling system becomes available during such a transient, its restart could significantly reduce the down-time. This report used the THATCH code to examine whether such restart, during a period of elevated core temperatures, can be accomplished within safe limits for fuel and metal component temperatures. If the reactor is scrammed, either system can apparently be restarted at any time, without exceeding any safe limits. However, under unscrammed conditions a restart of forced cooling can lead to recriticality, with fuel and metal temperatures significantly exceeding the safety limits.

26365 (NUREG/CR–6013) **Methods used for the treatment of non-proportionally damped structural systems.** Conoscente, J.P. (EQE Engineering Consultants, San Francisco, CA (United States)); Maslenikov, O.R.; Johnson, J.J. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Engineering; EQE Engineering Consultants, San Francisco, CA (United States). May

1993. 89p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Source: OSTI; NTIS; INIS; GPO.

Non-proportional or non-classical damping is defined as a form of viscous damping that introduces coupling between the undamped modal coordinates of motion. Such problems have practical applications in the dynamic analysis of soil-structure systems, structure-equipment systems, and structural systems made of materials with different energy dissipation capacities, which is applicable to seismic analysis of nuclear power plants. Presented in this report is a review of the methods most commonly used in structural analysis for the solution of the dynamic response of systems with non-proportional damping. Both rigorous and approximate methods are described. Since rigorous methods usually require large computational efforts, approximate methods using undamped mode shapes are often preferred. In the study described here, the accuracy of three approximate methods was evaluated for three benchmark problems, with various parametric variations. Results were compared with the exact solution for different combinations of structural properties. Based on these results, conclusions and recommendations are presented for the use of the selected approximate methods.

26366 (NUREG/CR–6061) **Determination of the bias in LOFT fuel peak cladding temperature data from the blowdown phase of large-break LOCA experiments.** Berta, V.T. (EG and G Idaho, Inc., Idaho Falls, ID (United States)); Hanson, R.G.; Johnsen, G.W.; Schultz, R.R. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Systems Research; EG and G Idaho, Inc., Idaho Falls, ID (United States). May 1993. 106p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC07-76ID01570. (EGG–2610). Source: OSTI; NTIS; INIS; GPO.

Data from the Loss-of-Fluid Test (LOFT) Program help quantify the margin of safety inherent in pressurized water reactors during postulated loss-of-coolant accidents (LOCAs). As early as 1979, questions arose concerning the accuracy of LOFT fuel rod cladding temperature data during several large-break LOCA experiments. This report analyzes how well externally-mounted fuel rod cladding thermocouples in LOFT accurately reflected actual cladding surface temperature during large-break LOCA experiments. In particular, the validity of the apparent core-wide fuel rod cladding quench exhibited during blowdown in LOFT Experiments L2-2 and L2-3 is studied. Also addressed is the question of whether the externally-mounted thermocouples might have influenced cladding temperature. The analysis makes use of data and information from several sources, including later, similar LOFT Experiments in which fuel centerline temperature measurements were made, experiments in other facilities, and results from a detailed FRAP-T6 model of the LOFT fuel rod. The analysis shows that there can be a significant difference (referred to as bias) between the surface-mounted thermocouple reading and the actual cladding temperature, and that the magnitude of this bias depends on the rate of heat transfer between the fuel rod cladding and coolant. The results of the analysis demonstrate clearly that a core-wide cladding quench did occur in Experiments L2-2 and L2-3. Further, it is shown that, in terms of peak cladding temperature recording during LOFT large-break LOCA experiments, the mean bias is 11.4 $\pm$ 16.2K (20.5 $\pm$ 29.2° F). The best-estimate value of peak cladding temperature for LOFT LP-02-6 is 1,104.8 K. The best-estimate peak cladding temperature for LOFT LP-LB-1 is 1284.0 K.

26367 (NUREG/IA–0092) **Assessment of RELAP5/MOD2 computer code against the Net Load Trip Test data from Yong-Gwang, Unit 2.** Arne, N. (Korea Electric Power Co., Taejeon (KR)); Cho, S.; Lee, S.H. Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Korea Electric Power Co., Taejon (Korea, Republic of); Korea Inst. of Nuclear Safety, Taejon (Korea, Republic of). Jun 1993. 64p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Source: OSTI; NTIS; INIS; GPO.

The results of the RELAP5/MOD2 computer code simulation for the 100% Net Load Trip Test in Yong-Gwang Unit 2 are analyzed here and compared with the plant operation data. The control systems for the control rod, feedwater, steam generator level, steam dump, pressurizer level and pressure are modeled to be functioned automatically until the power level decreases below 30% nuclear power. A sensitivity study on control rod worth was carried out and it was found that variable rod worth should be used to achieve good prediction of neutron power. The results obtained from RELAP5/MOD2 simulation agree well with the plant operating data and it can be concluded that this code has the capability in analyzing the transient of this type in a best estimate means.

26368 (NUREG/IA–0095) **RELAP5 assessment using LSTF test data SB-CL-18.** Lee, S. (Korea Inst. of Nuclear Safety, Taejon (Korea, Republic of)); Chung, B.D.; Kim, H.J. Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Korea Inst. of Nuclear Safety, Taejon (Korea, Republic of). May 1993. 216p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Source: OSTI; NTIS; INIS; GPO.

A 5 % cold leg break test, run SB-CL-18, conducted at the Large Scale Test Facility (LSTF) was analyzed using the RELAP5/MOD2 Cycle 36.04 and the RELAP5/MOD3 Version 5m5 codes. The test SB-CL-18 was conducted with the main objective being the investigation of the thermal-hydraulic mechanisms responsible for the early core uncovery, including the manometric effect due to an asymmetric coolant holdup in the steam generator upflow and downflow side. The present analysis, carried out with the RELAP5/MOD2 and MOD3 codes, demonstrates the code's capability to predict, with sufficient accuracy, the main phenomena occurring in the depressurization transient, both from a qualitative and quantitative point of view. Nevertheless, several differences regarding the evolution of phenomena and affecting the timing order have been pointed out in the base calculations. The sensitivity study on the break flow and the nodalization study in the components of the steam generator U-tubes and the cross-over legs were also carried out. The RELAP5/MOD3 calculation with the nodalization change resulted in good predictions of the major thermal-hydraulic phenomena and their timing order.

26369 (NUREG/IA–0104) **RELAP5/MOD3 assessment using the Semiscale 50% Feed Line Break test S-FS-11.** Lee, E.J. (Korea Inst. of Nuclear Safety, Taejon (Korea, Republic of)); Chung, B.D.; Kim, H.J. Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Korea Inst. of Nuclear Safety, Taejon (Korea, Republic of). Jun 1993. 175p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Source: OSTI; NTIS; INIS; GPO.

The RELAP5/MOD3 5m5 code was assessed using the 1/1705 volume scaled Semiscale 50% Feed Line Break (FLB) test S-FS-11. Test S-FS-11 was designed in three phases: (a) blowdown phase, (b) stabilization phase, and (c) refill phase. The first objective was to assess the code applicability to 50% FLB situation, the second was to evaluate the FSAR conservatisms regarding SG heat transfer degradation, steam line check valve failure, break flow state, and peak primary system pressure, and the third was to validate the EOP effectiveness. The code was able to simulate the major T/H parameters except for the two-phase break flow and the secondary convective heat transfer rate. The two-phase break flow had still deficiencies. The current boiling heat transfer rate was developed from the data for flow inside of a heated tube, not for flow around heated tubes in a tube bundle. Results indicated that the assumption of 100% heat transfer until the liquid inventory depletion was not conservative, the failed affected steam generator main steam line check valve assumption was not either conservative, the measured break flow experienced all types of flow conditions, the relative proximity to the 110% design pressure limit was conservative. The automatic actions during the blowdown phase were effective in mitigating the consequences. The stabilization operation performed by operator actions were effective to permit natural circulation cooldown and depressurization. The voided secondary refill operations also verified the effectiveness of the operations while recovering the inventory in a voided steam generator.

26370 (NUREG/IA–0120) **Assessment of the turbine trip transient in Cofrentes NPP with TRAC-BF1.** Castrillo, F. (Hidroelectrica Espanola, Madrid (Spain)); Gomez, A.; Gallego, I. Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Union Electrica, SA, Madrid (Spain). Jun 1993. 65p. Sponsored by Nuclear Regulatory Commission,

Washington, DC (United States). (EST-SIAN–22). Source: OSTI; NTIS; INIS; GPO.

This report presents the results of the assessment of TRAC-BF1 (G1-J1) code with the model of C. N. Cofrentes for simulation of the transient originated by the manual trip of the main turbine. C. N. Cofrentes is a General Electric designed BWR/6 plant, with a nominal core thermal power of 2894 Mwt, in commercial operation since 1985, owned and operated by Hidroelectrica Española, S. A. The plant incorporates all the characteristics of BWR/6 reactors, with two turbine driven FW pumps. As a result of this assessment a model of C. N. Cofrentes has been developed for TRAC-BF1 that fairly reproduces operational transient behavior of the plant. A special purpose code was generated to obtain reactivity coefficients, as required by TRAC-BF1, from the 3D simulator.

26371 (NUREG/IA–0123) **Application of full power blackout for C. N. Almaraz with RELAP5/MOD2.** Lechas, A.L. (C. N. Almaraz I y II, Madrid (ES)). Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Central Nuclear de Almaraz, Madrid (Spain). Jun 1993. 98p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). (ICSP–AL-BOUT-R). Source: OSTI; NTIS; INIS; GPO.

The analysis group of Almaraz Nuclear Power Plant has developed a model of the plant with RELAP 5/MOD.2/36:04. This model is the result of the work-experience on the code RELAP 5/MOD.1/ that was the standard code during the period 1984–1989. Different solutions were adopted in the network to implement the RELAP 5/ MOD.1/CY computer code. The first complete calculation of an accident (normal power blackout) was undertaken. All calculations presented in this report were performed on a computer CDC Cyber 180/830. The CPU time versus real time event was 22.6.

26372 (ORNL/FTR–4256) **Travel to collect data on boiling water reactor (BWR) instability events in Sweden and Spain: Trip report, May 4–14, 1992.** March-Leuba, J.A. Oak Ridge National Lab., TN (United States). 26 May 1992. 15p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93011083. Source: OSTI; NTIS (US Sales Only); GPO Dep.

There is a high level of activity in the area of boiling water reactor (BWR) stability in Europe, which is due in part to the higher number of instability events that have been observed in Europe. (Only three instabilities have been observed in the United States.) Most of these European events have occurred during special stability testing, but some of them have occurred unexpectedly and have resulted in either automatic or manual scrams. In the United States two events have been unexpected (LaSalle and Vermont Yankee), and one (Vermont Yankee) occurred during special stability tests. In general, BWR stability is considered in Europe to be more an operational problem than a safety problem. Significant emphasis is placed on having operator awareness and appropriate instrumentation so that unstable oscillations will be easily recognized and suppressed. Most Swedish BWRs use (or plan to use in the near future) stability monitors to avoid possible areas of instability during startup and load-following operations.

26373 (ORNL/NPR–92/64) **Pipe break testing of primary loop piping similar to Department of Energy's New Production Reactor-Heavy Water Reactor: Final report.** Poole, A.B.; Battiste, R.L.; Clinard, J.A. Oak Ridge National Lab., TN (United States). Jan 1993. 159p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93013423. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report provides information about and results from specific tests completed at Oak Ridge National Laboratory (ORNL) in support of the Department of Energy's (DOE's) New Production Reactor-Heavy Water Reactor (NPR-HWR) program. The report also provides detailed analytical studies completed by Battelle Columbus Laboratory and Argonne National Laboratory. All of this information is presented in a demonstrationthat the primary piping of the NPR-HWR, with its relatively moderate temperature and pressure should not suffer an instantaneous double-ended-guillotine-break (DEGB) under design basis loadings and conditions.

26374 (SAND–90-0234, pp. 1.1-1.5) **Introduction.** Bergeron, K.D. Sandia National Labs., Albuquerque, NM (United States). Jan 1993. (NPRW-SA–0234). In *Ex-vessel severe accident review for the Heavy Water New Production Reactor.* 372p. Order Number DE93010608. Source: OSTI; NTIS (US Sales Only).

The Introduction provides an overview of the Department of Energy's plans for design, construction, and startup of a Heavy Water New Production Reactor (HW-NPR) and or a Modular High Temperature Gas-Cooled New Production Reactor (MHTGR-NPR) and the need to review applicable accident information for plants of this type. The goals of the report are reviewed. The organization of the eight chapters of this report is outlined. Phenomena addressed include molten core-concrete interactions, fuel-coolant interactions, and gas combustion. 3 refs., 1 fig.

26375 (SAND–90-0234, pp. 2.1-2.10) **A rationale for studying severe accidents.** Bergeron, K.D. Sandia National Labs., Albuquerque, NM (United States). Jan 1993. (NPRW-SA–0234). In *Ex-vessel severe accident review for the Heavy Water New Production Reactor.* 372p. Order Number DE93010608. Source: OSTI; NTIS (US Sales Only).

This chapter assesses the value of an NPR severe accident program and explores the importance of the program with regard to the appropriate level, structure, and timing of the DOE/NP severe accident program. Section 2 reviews the unique needs of the NPR severe accident program. Section 3 describes the users of information generated by the NPR severe accident program. Section 4 evaluates the impact of regulatory uncertainty on long-range planning of the NPR severe accident program. Section 6 describes the interface of the NPR severe accident program with design activities. Section 6 discusses the interface of probabilistic risk assessment with accident information. Section 7 summarizes the important points presented in the chapter. 1 ref.

26376 (SAND–90-0234, pp. 3.1-3.19) **In-vessel melt progression in the HW-NPR.** Gauntt, R.O.; Kelly, J.E. Sandia National Labs., Albuquerque, NM (United States). Jan 1993. (NPRW-SA–0234). In *Ex-vessel severe accident review for the Heavy Water New Production Reactor.* 372p. Order Number DE93010608. Source: OSTI; NTIS (US Sales Only).

Perhaps the greatest uncertainty with respect to melt progression in the HW-NPR is the ultimate choice for the fuel design. It is expected that in-vessel melt progression processes will have a major effect on fission product release and containment loads. Hence, understanding the processes associated with core melt progression is extremely important for understanding severe accidents in the HWR. Some methods of designing-out recriticality potential as well as some alternative mitigating strategies are discussed. This chapter reviews the SRS melt progression technology base in Section 2, focusing on LWR/HW-NPR differences. Hydrogen generation in U/Al fuels is described is Section 3. In Section 4, debris coolability and lower vessel wall melt-through are assessed. Section 5 summarizes the findings of the chapter and draws conclusions regarding in-vessel melt progression in the HW-NPR. 23 refs., 2 figs., 1 tab.

26377 (SAND–90-0234, pp. 4.1-4.117) **Prevention and mitigation of core debris interactions with concrete.** Powers, D.A.; Bradley, D.R.; Chu, T.Y.; Copus, E.R. Sandia National Labs., Albuquerque, NM (United States). Jan 1993. (NPRW-SA–0234). In *Ex-vessel severe accident review for the Heavy Water New Production Reactor.* 372p. Order Number DE93010608. Source: OSTI; NTIS (US Sales Only).

The behavior of core materials once they have escaped the reactor coolant system and have begun to interact with structural material in a reactor containment during a severe accident hypothesized to occur in the HW-NPR is discussed in this chapter. The discussions concentrate on the interactions of core materials with concrete. A principal thrust of this chapter is to provide bases for the design of the HW-NPR that prevents or mitigates core material interactions outside the reactor coolant system and thus eliminates or mitigates the loads on the reactor containment and the radioactivity releases associated with the interactions. A summary review of the findings of the light-water reactor (LWR) research on ex-vessel core debris interactions is presented as is a review of results obtained to date in the work sponsored by the Savannah

River Site on ex-vessel interactions of debris. A review of strategies for mitigating or preventing ex-vessel core debris interaction is presented. The chapter concludes with a discussion of two options that appear to be attractive means for preventing or mitigating core debris interactions with concrete in the HW-NPR. Data needed to implement these options are described in the final section of the chapter. 133 refs., 47 figs., 10 tabs.

26378 (SAND–90-0234, pp. 5.1-5.65) **Molten fuel-coolant interactions.** Berman, M.; Beck, D.F.; Nelson, L.S.; Young, M.F. Sandia National Labs., Albuquerque, NM (United States). Jan 1993. (NPRW-SA–0234). In *Ex-vessel severe accident review for the Heavy Water New Production Reactor.* 372p. Order Number DE93010608. Source: OSTI; NTIS (US Sales Only).

When a hot liquid (fuel) comes into contact with a cold liquid (coolant), a variety of different fuel-coolant interactions (FCIs) can occur. For the heavy water reactor (HWR), the coolant of interest is water. The FCIs can range from quiescent boiling to explosive fragmentation of the fuel and rapid steam generation. This section discusses past FCI research in general and also as it pertains to the safety of the New Production Reactor (NPR) under severe accident conditions. Some mitigative and preventative strategies that might enhance NPR safety without requiring extensive research to reduce phenomenological uncertainties are also discussed. 158 refs., 8 figs., 1 tab.

26379 (SAND–90-0234, pp. 6.1-6.54) **Hydrogen distribution and combustion.** Tieszen, S.R.; Sherman, M.P.; Slezak, S.E.; Stamps, D.W.; Tills, J.L. Sandia National Labs., Albuquerque, NM (United States). Jan 1993. (NPRW-SA–0234). In *Ex-vessel severe accident review for the Heavy Water New Production Reactor.* 372p. Order Number DE93010608. Source: OSTI; NTIS (US Sales Only).

Hydrogen combustion is important because it can affect both safety-related equipment and containment integrity. The focus of this chapter is on hydrogen distribution and combustion that is relevant to the HW-NPR. Conditions are described when hydrogen combustion can occur. The consequences of hydrogen combustion are assessed. Various strategies for eliminating the threat of combustion or mitigating its consequences are discussed. 131 refs., 14 figs.

26380 (SAND–90-0234, pp. 7.1-7.31) **Additional containment threats and mitigation strategies.** Williams, D.C.; Breeding, R.J. Sandia National Labs., Albuquerque, NM (United States). Jan 1993. (NPRW-SA–0234). In *Ex-vessel severe accident review for the Heavy Water New Production Reactor.* 372p. Order Number DE93010608. Source: OSTI; NTIS (US Sales Only).

This chapter briefly discusses several issues pertinent to containment and mitigation. Sections 2 and 3 are devoted to discussions of accident sequences in which the containment is defeated at the outset, either because the accident sequence involves a release path bypassing the containment or because the containment is not isolated properly. Section 4 discusses threats posed by missiles which could be generated in certain energetic events: recriticality, steam explosions, and hydrogen detonations. Section 5 discusses FCI-driven fuel dispersal phenomena, in which steam generated by fuel-coolant interactions (FCI) may disperse fuel debris into the containment and thereby heat and pressurize the containment atmosphere and/or threaten containment liner integrity by direct contact with hot debris. Section 6 discusses slow overpressurization of the containment, which may eventually occur if containment heat removal is lost for long time periods (days). In each of these sections mitigation strategies are briefly addressed. Section 7 discusses the concept of designing the containment so that relatively rigorous deterministic analysis can demonstrate that it will withstand any credible severe accident threat, without resort to probabilistic arguments. Finally, Section 8 summarizes the most important points developed in this chapter. 27 refs., 3 figs.

26381 (SAND–90-0234, pp. 8.1-8.35) **Computer codes and accident analysis.** Bergeron, K.D.; Kelly, J.E. Sandia National Labs., Albuquerque, NM (United States). Jan 1993. (NPRW-SA–0234). In *Ex-vessel severe accident review for the Heavy Water New Production Reactor.* 372p. Order Number DE93010608. Source: OSTI; NTIS (US Sales Only).

This chapter deals with calculational methods in general; hence there there is no specific phenomenological focus, and no discussion of mitigative design strategies. The goal of this chapter is to take advantage of many years of experience gained in the past concerning severe accident computer code development and use, and to provide guidelines for those who develop NPR severe accident codes, those who apply the codes to specific accident analyses, and those who must interpret the significance of the results. Section 2 describes the most important uses of these codes and explains the logic behind the "two-tier" approach for code development. Section 3 is a brief discussion of the impact of uncertainty on the development and use of codes. Section 4 explains the purpose and structure of systematic procedures to control the development, distribution, and use of these codes as they evolve in time. Finally, Section 5 illustrates how accident analyses using system-level severe accident codes can qualitatively change perceptions about dominant effects, sometimes predicting results which are initially counter-intuitive, but upon inspection result from synergistic effects which can only be seen in an integrated analysis. 22 refs., 3 figs., 2 tabs.

26382 (SAND–91-1544) **NPR/FCI EXO-FITS experiment series report.** Rightley, M.J.; Beck, D.F.; Berman, M. Sandia National Labs., Albuquerque, NM (United States). Jan 1993. 148p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (NPRW-SA–91-3). Order Number DE93013950. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report discusses a test series investigating intermediate-scale ex-vessel fuel-coolant interaction (FCI) phenomena for aluminum melt materials which has been completed at Sandia National Laboratories (SNL), Albuquerque, NM. These tests were conducted for the Department of Energy's Office of New Production Reactors as part of the HWR Engineering Development Plan (EDP, WBS element 1.9.3-1). This document is the final report on the first phase of testing at SNL and represents completion of milestone 1.9.3 C of the EDP. The experiments, known as the NPR/FCI EXO-FITS Test Series, were conducted between 10 May 1990 and 30 January 1991 at the Explosive Dynamics Laboratory at SNL.

26383 (SAND–92-2774) **Containment loads scoping calculations for severe nuclear reactor accidents.** Williams, D.C. (Sandia National Labs., Albuquerque, NM (United States)); Gregory, J.J.: Tieszen, S.R.; Tills, J.L. Sandia National Labs., Albuquerque, NM (United States); Tills (Jack) and Associates, Inc., Albuquerque, NM (United States). Feb 1993. 185p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (NPRW-SA–90-5). Order Number DE93015608. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Scoping calculations are reported for the assessment of containment loads in the Heavy Water-New Production Reactor. Classes of loads considered include both design basis accident loads and severe accident loads. In the former category, loads following a large-break loss-of-coolant accident and loads associated with long-term heat removal with only passive heat removal systems operating are analyzed. Potential severe accident loads considered include blast loads associated with hydrogen detonation, rapid pressurization loads associated with energetic events, and long-term thermal and pressure loads with only passive heat removal systems operating following a severe accident. The latter include analysis of alternate designs with a refractory-lined dry cavity. The analyses presented include parametric and phenomenological sensitivity studies that provide insights into how the loads depend upon certain details of the accidents and/or the plant design. Given additional design-specific information, which was not available at the time of this study, the results will provide insight as to the severity of the containment loads that may result from specific accident sequences. In addition, the results provide some guidance as to how certain design features can be used to minimize the threat to containment integrity associated with loads of the types considered.

26384 (SAND–93-1067C) **Preliminary nuclear safety assessment of the NEPST (Topaz II) space reactor program.** Marshall, A.C. Sandia National Labs., Albuquerque, NM (United States). [1993]. 8p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9305179–1: 2. specialists conference and short course on

thermionic energy conversion, Goteborg (Sweden), 3-7 May 1993). Order Number DE93012853. Source: OSTI; NTIS; INIS; GPO Dep.

The United States (US) Strategic Defense Initiative Organization (SDIO) decided to investigate the possibility of launching a Russian Topaz II space nuclear power system. A preliminary nuclear safety assessment was conducted to determine whether or not a space mission could be conducted safely and within budget constraints. As part of this assessment, a safety policy and safety functional requirements were developed to guide both the safety assessment and future Topaz II activities. A review of the Russian flight safety program was conducted and documented. Our preliminary nuclear safety assessment included a number of deterministic analyses, such as; neutronic analysis of normal and accident configurations, an evaluation of temperature coefficients of reactivity, a reentry and disposal analysis, an analysis of postulated launch abort impact accidents, and an analysis of postulated propellant fire and explosion accidents. Based on the assessment to date, it appears that it will be possible to safely launch the Topaz II system in the US with a modification to preclude water flooded criticality. A full scale safety program is now underway.

26385 (UCRL-JC–110275-Rev.1) **A human reliability analysis of the University of New Mexico's AGN- 201M nuclear research reactor: Revision 1.** Brumburgh, G.P. (Lawrence Livermore National Lab., CA (United States)); Heger, A.S. Lawrence Livermore National Lab., CA (United States). 15 Oct 1992. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9301102–3-Rev.1: American Nuclear Society (ANS) meeting, Clearwater, FL (United States), 27 Jan 1993). Order Number DE93012475. Source: OSTI; NTIS; INIS; GPO Dep.

During 1990–1991, a probabilistic risk assessment was conducted on the University of New Mexico's AGN-201M nuclear research reactor to address the risk and consequence of a maximum hypothetical release accident. The assessment indicated a potential for consequential human error to precipitate Chis scenario. Subsequently, a human reliability analysis was performed to evaluate the significance of human interaction on the reactor's safety systems. This paper presents the results of that investigation.

26386 (WINCO–11908) **SHEAN (Simplified Human Error Analysis code) and automated THERP.** Wilson, J.R. Westinghouse Idaho Nuclear Co., Inc., Idaho Falls, ID (United States). [1993]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-84ID12435. (CONF-9302122–1: GOCO database meeting, Augusta, GA (United States), 2-3 Feb 1993). Order Number DE93014904. Source: OSTI; NTIS; INIS; GPO Dep.

One of the most widely used human error analysis tools is THERP (Technique for Human Error Rate Prediction). Unfortunately, this tool has disadvantages. The Nuclear Regulatory Commission, realizing these drawbacks, commissioned Dr. Swain, the author of THERP, to create a simpler, more consistent tool for deriving human error rates. That effort produced the Accident Sequence Evaluation Program Human Reliability Analysis Procedure (ASEP), which is more conservative than THERP, but a valuable screening tool. ASEP involves answering simple questions about the scenario in question, and then looking up the appropriate human error rate in the indicated table (THERP also uses look-up tables, but four times as many). The advantages of ASEP are that human factors expertise is not required, and the training to use the method is minimal. Although not originally envisioned by Dr. Swain, the ASEP approach actually begs to be computerized. That WINCO did, calling the code SHEAN, for Simplified Human Error ANalysis. The code was done in TURBO Basic for IBM or IBM-compatible MS-DOS, for fast execution. WINCO is now in the process of comparing this code against THERP for various scenarios. This report provides a discussion of SHEAN.

26387 (WSRC-MS–92-370-Rev.1) **A comparison of response spectrum and direct integration analysis methods as applied to a nuclear component support structure: Revision 1.** Bryan, B.J.; Flanders, H.E. Jr. Westinghouse Savannah River Co., Aiken, SC (United States). [1992]. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-930702–16-Rev.1: Pressure vessels and piping conference, Denver, CO (United States), 25-29 Jul 1993). Order Number DE93011778. Source: OSTI; NTIS; INIS; GPO Dep.

Seismic qualification of Class I nuclear components is accomplished using a variety of analytical methods. This paper compares the results of time history dynamic analyses of a heat exchanger support structure using response spectrum and time history direct integration analysis methods. Dynamic analysis is performed on the detailed component models using the two methods. A nonlinear elastic model is used for both the response spectrum and direct integration methods. A nonlinear model which includes friction and nonlinear springs, is analyzed using time history input by direct integration. The loads from the three cases are compared.

26388 (WSRC-MS–93-048) **The application of modern safety criteria to restarting and operating the USDOE K-Reactor.** Dimenna, R.A.; Taylor, G.A.; Brandyberry, M.D. Westinghouse Savannah River Co., Aiken, SC (United States). [1993]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-9306189–1: NE '93: 4th annual scientific and technical conference of the Nuclear Society: nuclear energy and human safety, Nizhni Novgorod (USSR), 28 Jun - 2 jul 1993). Order Number DE93016175. Source: OSTI; NTIS; INIS; GPO Dep.

The United States Department of Energy's (USDOE's) K-reactor, a defense production reactor located at the Savannah River Site in Aiken, South Carolina, was shut down in the summer of 1988 for safety upgrades to bring it into conformance with modern safety standards prior to restart. Over the course of the succeeding four years, all aspects of the 35-year old reactor, including hardware, operations, and analysis, were upgraded to ensure that the reactor could operate safely according to standards similar to those applied to modern nuclear reactors. This paper describes the decision making processes by which issues were identified, priorities assigned, and analysis improved to enhance reactor safety. Special emphasis is given to the probabilistic risk assessment (PRA) decision making processes used to quantify the risks and consequences of operating the K-reactor, the analytical hierarchy process (AHP) used to identify key phenomena, and modifications made to the RELAP5 computer code to make it applicable to K-reactor analysis. The success of the project was demonstrated when the K-reactor was restarted in the summer of 1992.

26389 (WSRC-RP–92-445) **Functional Analysis and Thermal-Hydraulics Program Plan.** Paik, I.K.; Lord, R.; Parks, B. Westinghouse Savannah River Co., Aiken, SC (United States). 27 Mar 1992. 26p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93016136. Source: OSTI; NTIS; INIS; GPO Dep.

The purpose of this document is to set forth the Program Plan for the Functional Analysis and Thermal-Hydraulics (FA&TH) Program (herein after referred to as the "Program") for the 5 year period covering fiscal years 1992 thru 1996. Specifically, the actions planned by the Safety Analysis Group (SAG) of the Reactor Safety Research Section within SRTC will be identified, defined, and a schedule and resource projection presented. This document will be used by the Reactor Safety Research Section management as the baseline definition for the Program's scope, schedule and cost. Annual budget and staffing requests will be submitted based on this approved baseline. Status reporting and progress monitoring will be performed against this approved baseline. This Program plan will be revised as needed to reflect the changes that come about due to Program redirection. The Program's primary mission is to provide further assurance that the Savannah River Site K-Reactor is designed, modified, operated and maintained in a safe, cost-effective manner through application of functional analysis methodology and continued development of thermal hydraulic support capabilities. It is envisioned that the Program will continue throughout the operating life of K-Reactor and have a permanent staff of eight: one lead and seven engineers. The Program has two primary elements; (1) functional analysis, and (2) thermal-hydraulics. Functional analysis is the first element of the formal Systems Engineering Process. Systems Engineering methodology is commonly applied in both commercial and military programs, particularly where the needs of the program involve complex interrelationships between hardware,

software, personnel, and support facilities. It has been extensively used in development of military systems, and in the commercial sector in the development of designs for nuclear power reactors.

26390 (WSRC-RP–92-720) **Steam explosion analysis in support of the SRS reactor safety assessment.** Vonderfecht, B.E.; Smith, D.C. Westinghouse Savannah River Co., Aiken, SC (United States). 9 Oct 1992. 57p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93014750. Source: OSTI; NTIS; INIS; GPO Dep.

This report describes the application of two steam explosion models in support of the Probabilistic Risk Assessment (PRA) for the Savannah River Reactors. Theoretical models are required to estimate steam explosion yields in terms of kinetic energy, pressure shock and steam generated by the event. These quantities are used in the PRA to determine fission product barrier integrity in the reactor confinement following a hypothetical steam explosion. The basic preconditions for a steam explosion are that hot molten material come into contact with water, and that the material's temperature be high enough to both support film boiling at its surface, and remain molten until an explosion is initiated. In a number of PRA accident sequences, aluminum-uranium debris will be hot enough to participate in a steam explosion. The high pressure vapor produced, the shock waves, and the kinetic energy of material can all do destructive work on structures surrounding the explosion site. Fuel melting is possible during several postulated severe accident scenarios for the SRS reactors. In many cases, water will exist in the reactor primary system and/or on the confinement building floor. Steam explosions must be characterized by a few significant parameters that can be addressed in the PRA. These parameters are the quantity of steam produced, and the amount of mechanical work performed. The model must be both computationally efficient and realistic. The present work employs a bounding model based on the assumption of thermodynamic equilibrium within the explosion and a non-equilibrium model which accounts for irreversible processes to achieve more realistic results.

26391 (WSRC-RP–92-1136) **Probabilistic treatment of a long-term shutdown event with peak xenon and failed rods: Task: PRA.** Topp, S.V. Westinghouse Savannah River Co., Aiken, SC (United States). Sep 1992. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93014755. Source: OSTI; NTIS; INIS; GPO Dep.

This document describes PRA techniques used to estimate the frequency of occurrence of a chain of events postulated under Section 15.4.4.2 of the K-Reactor SAR, "Other Reactivity Additions During Shutdown." This scenario is related to the requirements in Technical Specification 3.1.3, "Reactivity Requirements-Shutdown."

26392 (WSRC-TR–91-372-Rev.2) **GAM-HEAT: A computer code to compute heat transfer in complex enclosures: Revision 2.** Cooper, R.E.; Taylor, J.R. Westinghouse Savannah River Co., Aiken, SC (United States). Dec 1992. 100p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93014724. Source: OSTI; NTIS; GPO Dep.

This report discusses the GAM_HEAT code which was developed for heat transfer analyses associated with postulated Double Ended Guilliotine Break Loss Of Coolant Accidents (DEGB LOCA) resulting in a drained reactor vessel. In these analyses the gamma radiation resulting from fission product decay constitutes the primary source of energy as a function of time. This energy is deposited into the various reactor components and is re-radiated as thermal energy. The code accounts for all radiant heat exchanges within and leaving the reactor enclosure. The SRS reactors constitute complex radiant exchange enclosures since there are many assemblies of various types within the primary enclosure and most of the assemblies themselves constitute enclosures. GAM-HEAT accounts for this complexity by processing externally generated view factors and connectivity matrices as discussed below, and also accounts for convective, conductive, and advective heat exchanges. The code is structured such that it is applicable for many situations involving heat exchange between surfaces within a radiatively passive medium.

26393 (WSRC-TR–91-430) **Verification, validation, and benchmarking report for AXLIB4: A processor to generate JOSHUA records of axial power shape versus time.** Le, T.T. Westinghouse Savannah River Co., Aiken, SC (United States). Jul 1991. 44p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93016125. Source: OSTI; NTIS; INIS; GPO Dep.

AXLIB4 is a transient one-dimensional diffusion theory calculation written to provide JOSHUA records of assembly axial power shapes versus time at start and end of subcycle while safety rods are falling during a scram. The WIGGLE program written by R. E. Pevey provides the diffusion theory calculation. AXLIB4 is not a stand-alone code and is connected to LLAP through an EXECUTE statement and JOSHUA interface libraries. The input data are passed to AXLIB4 from a driver routine (LLAP) and from interface JOSHUA records linking the code to the driver routine database. This report concerns the verification and validation of AXLIB4. The verification was performed to determine if AXLIB4 was using the correct theory and that all the subroutines function as required. The validation was performed by comparing the results of the code with the analytical solutions of test problems. The first test problem is a heterogeneous calculation using a pre-accident power profile (includes end-fittings); this problem is designed to test the calculation of total and decay heat assembly powers input versus time, and the initial power shape calculation. The second test problem is a homogeneous problem designed to test the initial and transient power shape calculational ability. These two test problems and their analytical solutions are repeated from the Benchmarking Report for WIGGLE written by R. E. Pevey. Since the results of these two benchmark solutions were identical to the analytical solutions, it is the conclusion of this study that AXLIB4 was correctly implemented and is ready to submit to SCMS.

26394 (WSRC-TR–92-029) **Uninstrumented assembly airflow testing in the Annular Flow Distribution facility.** Kielpinski, A.L. Westinghouse Savannah River Co., Aiken, SC (United States). Feb 1992. 360p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93016841. Source: OSTI; NTIS; GPO Dep.

During the Emergency Cooling System phase of a postulated large-break loss of coolant accident (ECS-LOCA), air enters the primary loop and is pumped down the reactor assemblies. One of the experiments performed to support the analysis of this accident was the Annular Flow Distribution (AFD) experiment, conducted in a facility built for this purpose at Babcock and Wilcox Alliance Research Center in Alliance, Ohio. As part of this experiment, a large body of airflow data were acquired in a prototypical mockup of the Mark 22 reactor assembly. This assembly was known as the AFD (or the I-AFD here) reference assembly. The I-AFD assembly was fully prototypical, having been manufactured in SRS's production fabrication facility. Similar Mark 22 mockup assemblies were tested in several test facilities in the SRS Heat Transfer Laboratory (HTL). Discrepancies were found. The present report documents further work done to address the discrepancy in airflow measurements between the AFD facility and HTL facilities. The primary purpose of this report is to disseminate the data from the U-AFD test, and to compare these test results to the I-AFD data and the U-AT data. A summary table of the test data and the B&W data transmittal letter are included as an attachment to this report. The full data transmittal volume from B&W (including time plots of the various instruments) is included as an appendix to this report. These data are further analyzed by comparing them to two other HTL tests, namely, SPRIHTE 1 and the Single Assembly Test Stand (SATS).

26395 (WSRC-TR–92-335) **USH cooling via Septifoils.** Spatz, T.L. Westinghouse Savannah River Co., Aiken, SC (United States). Nov 1992. 33p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93014746. Source: OSTI; NTIS; INIS; GPO Dep.

Following a hypothetical Loss of Coolant Accident (LOCA) the moderator level in the reactor tank would decrease. The current operating procedure with the new Type Q Septifoil is to maintain Septifoil cooling during a LOCA. With the Type Q Septifoil the coolant flows up the Septifoil to ports above and just below the Poison Plate where it is discharged into the reactor tank. The

coolant would then spray from the top of the Septifoil, splashing onto the Universal Sleeve Housings (USH) which house the assemblies, and enhance the cooling of the assemblies. The goal of the experiments performed in the HTL under Task Plan 92-062-1 was to determine the flow rate down the outside of the USH as a function of Septifoil flow. Information on USH cooling is necessary in the calculation of Gamma Heating Power Limits for K Reactor. This task (92-062-1) parallels a similar task (90-074-1) which was performed to redesign the Septifoil (Type Q) and verify its performance. The facility that was used was the same test facility as that used by the previous task, namely Poison Plate Flow Test Rig. A relationship between the flow rate inside a Septifoil to the water collected by an USH is presented. The test apparatus consisted of three Septifoils, each surrounded by six USHs. The geometry is prototypic of the reactor. Supplemental testing was performed after a preliminary investigation of the early results showed a drop in the USH collection flow rate near a Septifoil flow rate of about 7 GPM. The supplemental data supported the earlier data at low flow rate (<10 GPM) an expanded the range of data to 20 GPM by resolving nonprototypic issues.

26396 (WSRC-TR–93-0094) **Seismic II over I Drop Test Program results and interpretation.** Thomas, B. Westinghouse Savannah River Co., Aiken, SC (United States). Mar 1993. 379p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93014761. Source: OSTI; NTIS; INIS; GPO Dep.

The consequences of non-seismically qualified (Category 2) objects falling and striking essential seismically qualified (Category 1) objects has always been a significant, yet analytically difficult problem, particularly in evaluating the potential damage to equipment that may result from earthquakes. Analytical solutions for impact problems are conservative and available for mostly simple configurations. In a nuclear facility, the "sources" and "targets" requiring evaluation are frequently irregular in shape and configuration, making calculations and computer modeling difficult. Few industry or regulatory rules are available on this topic even though it is a source of considerable construction upgrade costs. A drop test program was recently conducted to develop a more accurate understanding of the consequences of seismic interactions. The resulting data can be used as a means to improve the judgment of seismic qualification engineers performing interaction evaluations and to develop realistic design criteria for seismic interactions. Impact tests on various combinations of sources and targets commonly found in one Savannah River Site (SRS) nuclear facility were performed by dropping the sources from various heights onto the targets. This report summarizes results of the Drop Test Program. Force and acceleration time history data are presented as well as general observations on the overall ruggedness of various targets when subjected to impacts from different types of sources.

26397 (YJT–90-16) **Microearthquakes in the Baltic shield: Seismotectonic analysis for nuclear power plant in the Loviisa area, South-eastern Finland.** Saari, J. (Imatran Voima Oy, Vantaa (Finland)). Nuclear Waste Commission of Finnish Power Companies, Helsinki (Finland). Nov 1990. [35p.] Order Number DE93630654. Source: OSTI; NTIS; INIS.

Microearthquake observations are used to study the local seismicity and seismotectonics in the Precambrian rapakivi granite, in the Loviisa area, SE Finland. The study area, around the nuclear power plant in Loviisa, is limited within a radius of 100 km. The results from local microearthquake network in the Loviisa area are presented. During six years of measuring, there were 29 micro- and ultra-microearthquakes (ML = 0.1 - 1.2) in the area. The events identify active faults in the area. The results are discussed with the framework of local seismotectonic interpretation. The estimated value of the peak slip is an important parameter connecting microearthquakes to geodynamical processes. The peak slip gives approximation to the size of seismic and aseismic movement in a certain fault and thus also an indication of ongoing tectonic processes. The movements in the active fault may continue for thousands of years. (orig.).

24 POWER TRANSMISSION AND DISTRIBUTION

2401 Power Systems

26398 (CONF-921273–) **Workshop on electric utility systems modeling.** Prasad, R.; Kittur, R.; Walker, R.; Marten, D. Energy Consultants, Inc., Las Cruces, NM (United States). [1992]. 274p. Sponsored by USDOE Federal Energy Regulatory Commission, Washington, DC (United States). From Workshop on electric utility systmes modeling; Las Cruces, NM (United States); 15-17 Dec 1992. Order Number DE93013924. Source: OSTI; NTIS.

The primary objective of this workshop is to obtain a clear understanding of the various details involved in developing electric utility models from public-domain information. The workshop is aimed at providing a thorough tutorial and a hands-on exercise in developing a set of relational databases that can be used to analyze the behavior of selected power systems. Because of several modeling details that can be utility-specific, issues that are common among all systems need to be addressed. These common issues include: Data collection from public-domain sources; generation of connectivity diagrams; generation/load/tie-line MW assignments; parameter database creation (.DAT); development of one-line database (.OL); development of geographic database (.GEO); error-checking between databases; development of power-flow data files (.DCD and IEE); and power-flow analysis.

2402 Power System Networks, Transmission and Distribution

Refer also to citation(s) 26398

2405 Environmental Aspects

Refer also to citation(s) 27652

2406 Legislation and Regulations

26399 (LBL–32231) **Transmission planning in the era of integrated resource planning: A survey of recent cases.** Baldick, R.; Kahn, E.P. Lawrence Berkeley Lab., CA (United States). Sep 1992. 171p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. Order Number DE93015242. Source: OSTI; NTIS; GPO Dep.

State action is critical to the expansion of the high-voltage transmission network, because regulated utilities must seek approval from utility commissions for proposals to site new lines. It is the purpose of this report to survey the regulatory treatment of issues that are unique to or ubiquitous in transmission planning and use. The authors review recent transmission siting cases to examine how the issues are presented to and resolved by state regulatory commissions and to provide a perspective for more general discussion of transmission policy. Their primary focus is on planning issues. Transmission capacity expansion is not typically treated in integrated resource planning. It is usually assumed that there is adequate transmission to achieve any particular plan. The authors believe that one important reason for this omission is the inherent complexity of transmission system expansion. Regulators and competitors may be at a serious disadvantage in negotiating or adjudicating specific transmission proposals with utilities, who generally have greater knowledge of both general technological considerations and case specifics. This problem of asymmetric information must be addressed at some level in planning or dispute resolution. However, they observe that explicit consideration of the information problem is absent from most regulatory and technical analysis of transmission. The goal of this survey is to share knowledge about the problems facing state regulators over the siting of new transmission facilities, and help to define constructive approaches to them.

2407 Economic, Industrial, and Business Aspects

Refer also to citation(s) 26469

26400 (DOE/EIA–0455(91)) **Electric plant cost and power production expenses 1991.** USDOE Energy Information Administration, Washington, DC (United States). Office of Coal, Nuclear, Electric and Alternate Fuels. 13 May 1993. 160p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93013929. Source: OSTI; NTIS; GPO; INIS; GPO Dep.

Electric Plant Cost and Power Production Expenses is prepared by the Survey Management Division; Office of Coal, Nuclear, Electric and Alternate Fuels (CNEAF); Energy Information Administration (EIA); US Department of Energy. This publication presents electric utility statistics on power production expenses and construction costs of electric generating plants. Data presented here are intended to provide information to the electric utility industry, educational institutions, Federal, State, and local governments, and the general public. These data are collected and published to fulfill data collection and dissemination responsibilities of the Energy Information Administration (EIA), as specified in the Federal Energy Administration Act (Public Law 93-275), as amended.

25 ENERGY STORAGE

2506 Thermal

Refer also to citation(s) 26516

2509 Batteries

Refer also to citation(s) 26560

26401 (LBL–33046) **In situ Raman spectroscopy of lithium electrode surface in ambient temperature lithium secondary battery: Final report.** Tachikawa, Hiroyasu (Jackson State Univ., MS (United States). Dept. of Chemistry). Lawrence Berkeley Lab., CA (United States). Sep 1992. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. Order Number DE93015238. Source: OSTI; NTIS; GPO Dep.

Raman spectroscopy was used to characterize surface layers on lithium electrodes in different solvents such as propylene carbonate (PC), dimethyl carbonate (DMC), diethyl carbonate (DEC), and polyethylene glycol 400 dimethyl ether (PEG400DME). Both DMC and DEC were used singly, and also mixed with either methyl acetate (MA) or methyl formate (MF). The Raman spectra showed that passive films formed on the Li surface in different solvents may have different chemical structures, which changed during the charging and discharging processes. Raman spectroscopy was also applied to characterize zinc electrode surfaces in alkaline solutions. The results suggested that ZnO and $Zn(OH)_2$ formed on the Zn electrode when a passive potential was applied. A solid film of fullerene C_{60}, which could be used as a cathode in Li rechargeable batteries, was examined in the PEG400DME solution by both electrochemical and Raman spectroscopy. Cyclic voltammograms (CVs) showed five redox peaks which suggested the formation of C_{60}^{-}, C_{60}^{2-}, C_{60}^{3-}, C_{60}^{4-}, and C_{60}^{5-}. Raman spectra obtained from a thin C_{60} film indicated that the thin fulleride film dissolved in the PEG400DME/$LiClO_4$ solution at negative potentials.

26402 (NEI-DK–1197) **Lithium accumulators: Final report.** Hennesoe, E.; Lambine, T.-L.; Mogensen, M. Risoe National Lab., Roskilde (Denmark). Materials Dept. Mar 1993. 261p. (In Danish). Contract EM-1443/88-2;Contract ENS-1443/89-2. Order Number DE93500356. Source: OSTI; NTIS.

EFP-88; EFP-89.

The publication contains two research reports on lithium accumulators. One describes research carried out on two different types of lithium batteries in glass and stainless-steel-can where the impedance was measured for several years and fitted for the circuit model LR(Q(R(C(RQ)))). In the other research project electrodes of sputtered Ni and stainless steel in electrolytes of type $LiAlCl_4,nSO_2$ ($2.3 \leq n \leq 4.1$) and 1.5M $LiAlCl_4$ in SO_2Cl_2 were tested using cyclic voltametry, frequency analysis, SEM, EDAX and X-ray diffraction. (AB).

26403 (NEI-DK–1197, pp. 1-143) **Precipitation of LiCl and Li from SO_2- and SO_2Cl_2-catholyte: Working report on Li accumultor project.** Lambine, T.-L. Risoe National Lab., Roskilde (Denmark). Materials Dept. Mar 1993. (In Danish). Contract EM-1443/88-2;Contract ENS-1443/89-2. In *Lithium accumulators: Final report.* 261p. Order Number DE93500356. Source: OSTI; NTIS.

EFP-88; EFP-89.

Electrodes of sputtered Ni and stainless steel (SS) in electrolytes of type $LiAlCl_4,nSO_2$ ($2.3<n<4.1$) and 1.5M $LiAlCl_4$ in SO_2Cl_2 are tested using cyclic voltametry, frequency analysis, SEM, EDAX and X-ray diffraction. In case of cyclic voltametry the nucleation potential is found independent of the type of catholyte. By precipitating 500 mum Li thread shaped Li is formed. This is more noticeable using $LiAlCl_4,nSO_2$ than $LiAlCl_4,SO_2Cl_2$. Nucleation potential is lower for Ni than for SS, and the current increases more rapidly when the nucleation potential is reached. So Ni is evaluated as more suitable for anodes than SS. The solid electrolyte interface (SEI) shortly after a step to 0 mV vs. Li/LiCl was thinner using n=2.6 than n=4.1. Addition of 2 w% PVC lead to the sinking of the nucleation potential by 30-50 mV and SEI thickness decreased after the step to 0 mV. However electrodes from the PVC experiments reacted extremely exothermly by the following dismounting in argon atmosphere. (au) (12 refs.).

26404 (NEI-DK–1197, pp. 1-131) **Lithium accumulator: Report on work carried out 1992-3.** Hennesoe, E. Risoe National Lab., Roskilde (Denmark). Materials Dept. Mar 1993. (In Danish). Contract EM-1443/88-2;Contract ENS-1443/89-2. In *Lithium accumulators: Final report.* 261p. Order Number DE93500356. Source: OSTI; NTIS.

EFP-88; EFP-89.

The impedance of different types of Li-batteries in glass and stainless steel can have been measured for several years and fitted for the circuit model LR(Q(R(C(RQ)))). The result is interpreted according to 5 models. The most reliable model assumes a primary layer having a constant thickness determinated by the tunneling effect and a porous secondary layer which has a significant electrolyte content that, along the surface of the primary layer is very open, but perpendicular to the surface has a rather blocked porous structure. Older cells that are regenerated with heavy loads show a low impedance with values that are in agreement with the hypothesis on an open structure between the primary and the secondary layer so that the latter will separate itself. Microcalorimetry has been shown to be suitable for determining the electron conductivity of the LiCl-layer, values are 3E-13 to 8E-11 S/cm. Comparing with the growth of the LiCl-layer it is shown that only 10% of the LiCl formed by self discharge is precipitated into the layer. (au).

26405 (NEI-DK–1208) **Organic electrolytes for sodium batteries.** Vestergaard, B. Danmarks Tekniske Hoejskole, Lyngby (Denmark). Kemisk Lab. A. Apr 1993. 238 p.p. Order Number DE93500397. Source: OSTI; NTIS.

The aim was to develop new electrolyte mixtures. 1-methyl-3-ethyl-imidazolium chloride (MEICl) mixed with aluminum chloride was the standard of reference. The new electrolytes should be utilized with sodium in room temperature batteries. Several triazolium chloride derivates were prepared, including 1-ethyl-4-methyl-1,2,4-triazolium chloride, 1,4-dimethyl-1,2,4-triazolium chloride, 1,2-dimethyl-1,2,3-triazolium chloride and 1-methyl-3-paramethoxy,benzyl-1,2,3-triazolium chloride. Other nitrogen containing ring systems like 1,2-dimethyl-pyrazolium chloride, 3-methyl-thiazolium chloride and MEICl were synthesized. An attempt to prepare 1,4-dimethyl-tetrazolium chloride was successful. Recrystallization procedures and the melting point or decomposition temperature for the salt are also described. $AlCl_3$ was added to the organic chloride salts and the reactions reported. Conductivity of 14dm124tcl:$AlCl_3$ and the 1m3pmb123tcl:$AlCl_3$ is compared with the MEICl:$AlCl_3$ system. Conductivities of the pure salts 14dm124tcl, 1e4m124tcl and 3mtzcl are listed. Voltammograms of < 3 mole % of 14dm124tcl in NaCl:$AlCl_3$ melts at 160-170 deg. C indicated that 14dm124tcl acted as a reversible anode in these melts. Results of AC-impedance measurements of sodium in basic MEICl:$AlCl_3$ melts are reported as internal cell resistance versus time. The resistance must be considered too big for battery applications (> 20000Ω after 1 hour). Results of AC-impedance

measurements of Neosepta^R an- or cation exchange membranes are given. Battery experiments with Na/Nasicon/$FeCl_3$:MEICl:$AlCl_3$/Mo showed a reduction of Fe^{3+} to Fe^{2+} by the electrolyte. 100% utilization of the formed Fe^{2+} cathodic capacity was possible. (AB) (142 refs.).

29 ENERGY PLANNING AND POLICY

Refer also to citation(s) 27656, 27657

26406 (DOE–76-45/28-Rev.1) **Glossary of SSDC terms and acronyms: Revision 1.** Horman, R.L. EG and G Idaho, Inc., Idaho Falls, ID (United States). Dec 1992. 159p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. (SSDC–28-Rev.1). Order Number DE93013697. Source: OSTI; NTIS; GPO Dep.

This combination glossary and list of acronyms and abbreviations was compiled to provide the user a ready reference to System Safety Development Center (SSDC) terms. The acronyms are from the publication INEL Acronyms published by the Technical Publications Group. This group updates these acronyms periodically; the version used in this report was dated October 1992.

26407 (DOE/CR–0016) **Semiannual report to Congress on Inspector General audit reports for the period October 1, 1992 to March 31, 1993.** USDOE Office of Inspector General, Washington, DC (United States). May 1993. 25p. Sponsored by USDOE, Washington, DC (United States). Source: OSTI (Free of Charge).

Report to The Secretary.

This is the Secretary of Energy's eighth Semiannual Report to Congress to be submitted under the Inspector General Act of 1978, as amended. Pursuant to the Inspector General Act Amendments of 1988 (Public Law 100-504), agency heads are to report to Congress on the status of final action taken on audit report recommendations. This report complements a report prepared by the Department's Office of Inspector General (IG) that provides information on audit reports issued during the period and on the status of management decisions made on IG audit reports. During the period covered by this report, October 1, 1992, to March 31, 1993, the Department took final action on six contract and financial assistance audit reports. At the end of the period only four reports awaited final action. With regard to operational, financial, and preaward audits, final action was taken on 15 reports, resulting in 95 audit reports needing final action at the end of the period. This report has three sections. The first outlines significant audit accomplishments achieved by the Department during the reporting period. The second section contains the statistical tables that illustrate the status of final action on IG audit reports. The third lists the audit reports that are one year or more past management decision and have not completed final action. This section also provides the status of corrective actions on each of these reports.

26408 (DOE/EIA–0035(93/04)) **Monthly energy review, April 1993.** USDOE Energy Information Administration, Washington, DC (United States). Office of Energy Markets and End Use. 28 Apr 1993. 160p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93012827. Source: OSTI; NTIS; GPO; GPO Dep.

Energy production during January 1993 totaled 5.7 quadrillion Btu, a 3.3-percent decrease compared with the level of production during January 1992. Coal production decreased 9.9 percent, petroleum production dropped 3.9 percent, and natural gas production increased 0.5 percent. All other forms of energy production combined were up 4.9 percent from the level of reduction during January 1992. Energy consumption during January 1993 totaled 7.7 quadrillion Btu, 0.4 percent above the level of consumption during January 1992. Coal consumption increased 2.2 percent, natural gas consumption was up 1.3 percent, and petroleum consumption dropped 2.8 percent. Consumption of all other forms of energy combined increased 5.1 percent compared with the level 1 year earlier.

26409 (DOE/ER/75760–1) **SET Careers Program: An interactive science, engineering, and technology career education exhibit: Annual progress report, September 1, 1992–October 31, 1993.** Cole, P.R. New York Hall of Science, NY (United States). 31 Mar 1993. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-92ER75760. Order Number DE93014095. Source: OSTI; NTIS; GPO Dep.

The New York Hall of Science, in response to the national crisis in education and employment in science and engineering, is developing and pilot testing a unique, interactive, video-based, hypermedia series on energy-related and other science and engineering careers for middle and junior high school students. Working in collaboration with the Consortium for Mathematics and its Applications (COMAP) and the Educational Film Center (EFC), this pilot-demonstration phase will last 14 months, during which time the basic design, production, and testing of eight science and engineering career modules (video and software) will be completed and installed as an interactive educational exhibit at the New York Hall of Science. This career education package will then be distributed to other science technology centers nationwide.

26410 (DOE/ER/75773–1) **[Michigan Technological University Pre-Service Teacher Enhancement Program]: Progress performance report.** Anderson, C.S.; Yarroch, W.L. Michigan Technological Univ., Houghton, MI (United States). 27 Apr 1993. 40p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-92ER75773. Order Number DE93013538. Source: OSTI; NTIS; GPO Dep.

The Michigan Technological University Teacher Education Program received funding from the US Department of Energy for the purpose of providing capable and suitably inclined, MTU Engineering and Science students a chance to explore high school level science and mathematics teaching as a career option. Ten undergraduate students were selected from nominations and were paired with mentor teachers for the study. This report covers the experience of the first ten nominees and their participation in the program.

26411 (DOE/IG–0001/93) **Office of Inspector General semiannual report to Congress, October 1, 1992–March 31, 1993.** USDOE Office of Inspector General, Washington, DC (United States). Apr 1993. 68p. Sponsored by USDOE, Washington, DC (United States). Source: OSTI (Free of Charge).

Report to The Secretary.

This Office of Inspector General Semiannual Report to the Congress covers the period from October 1, 1992, through March 31, 1993. The report summarizes significant audit, inspection and investigative accomplishments for the reporting period. Much of the work performed by the Office of Inspector General during this period was in areas relating to the material weaknesses identified by the previous Secretary in his Federal Managers' Financial Integrity Act letter to the President or in areas designated as "high risk" by the Office of Management and Budget. These "high risk" areas are identified and covered in this Semiannual Report to Congress, as is the other work done by the Office of Inspector General in response to mandated or legislated requirements. During this reporting period, the Office of Inspector General issued 96 audit reports. As a result of reviews of contract costs, the Office of Inspector General determined that $3.7 million in costs were either questionable or unsupported. Management committed to taking corrective actions which the Office of Inspector General estimates will result in a more efficient use of funds totaling $153 million. For reports issued during the period, the Office of Inspector General made recommendations that, when implemented by management, could result in $105 million being put to better use.

26412 (ORNL/FTR–4170) **Executive conference on energy technology policy for sustainable development: Comparing long-term approaches: Foreign trip report, December 6–17, 1991.** Fulkerson, W. Oak Ridge National Lab., TN (United States). 26 Dec 1991. 58p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93011091. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The traveler attended the conference (Energy Technology Policy for Sustainable Development: Comparing Long-Term Approaches) and he chaired the Keynote session. He also visited the University of Utrecht to discuss work they are doing on CO_2 sequestering and other energy technology and energy policy analyses. The NOVEM

conference was noteworthy both for its focus and because some interesting recommendations came out. Among the recommendations were that OECD nations are underinvesting in energy technology R&D given the greenhouse changes and that the underinvestment was most pronounced for energy efficiency and renewables which were underfunded compared to nuclear and fossil. The recommendations covered energy technologies, what to do about constraints to adopting energy technologies which are more compatible with sustainable development, and energy policy and analytical tools.

2901 Energy Analysis and Modeling

Refer also to citation(s) 28207

26413 (DOE/FTR–93013011) **Travel to Paris, France to attend the IAEE meeting and to present a paper on the method and the results of import substitution using alternative import vectors for the United States, France and Japan: Foreign trip report, May 17–24, 1992.** Roop, J.M. Pacific Northwest Lab., Richland, WA (United States). 20 Jun 1992. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93013011. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This is a trip report submitted after attendance at the IAEE meeting in France in May 1992. Notable items included a talk on the importance of politics in the pricing of oil and other plenary sessions on energy conservation, barriers to conservation investments, energy development in third world countries, community empowerment programs, and the out-sourcing of energy-intensive production. The meeting included with an OECD/IEA Expert Workshop on Life-cycle Analysis of energy systems.

2902 Economics and Sociology

Refer also to citation(s) 25618, 25659, 25887, 26219, 26433, 26435, 26437, 26445, 26453, 26457, 26464, 26465, 26466, 27658, 28156

26414 (CONF-9303181–1) **Purity and danger: Protection of Native American religious sites and knowledge in federal development.** Treitler, I.E. (Tennessee Univ., Knoxville, TN (United States). Energy, Environment and Resources Center). Oak Ridge National Lab., TN (United States). 3 Mar 1993. 18p. Sponsored by USDOE Federal Energy Regulatory Commission, Washington, DC (United States). DOE Contract AC05-84OR21400. From Society for Applied Anthropology meeting; San Antonio, TX (United States); 10-14 Mar 1993. Order Number DE93015483. Source: OSTI; NTIS; GPO Dep.

Social Impact Assessment (SIA) is the process by which the impacts of development projects on the social structure and culture of the potentially affected community are determined. This case study reports on the author's experience as a participant in the interaction between the Federal Energy Regulatory Commission (the Commission) and Native American Tribes concerned with the potential outcomes of the Commission's actions. Past and ongoing efforts of the Commission to develop assessment and analysis procedures that give priority to the Native American socio-cultural values are reviewed. Any generalizations drawn from this case study must be at a very broad, even theoretical level, and must be tested for each tribal population and each environmental context. Because the work is in progress, the efficacy of some of the methods documented has not been fully tested. The goal of this case study is to submit a preliminary evaluation of the interactions between the Commission and concerned Tribes in the project area.

26415 (DOE/FTR–93013562) **[Travel to Belarus and Russia to engage in bilateral discussions on a broad range of human resources topics]: Foreign trip report, April 13–26, 1992.** Sieber, H.A. Westinghouse Hanford Co., Richland, WA (United States). 1992. 39p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE93013562. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The trip was arranged to bring together a team of human resources management specialists from throughout the United States to visit Belarus and Russia. The delegation's purpose was to engage in bilateral discussions with foreign counterparts covering a broad range of human resources topics. Participation represented another avenue to demonstrate US support for the political, social and economic developments taking place within the former Soviet Union.

26416 (INIS-mf–13550) **Investing for a better environment.** European Bank for Reconstruction and Development, London (United Kingdom). 1993. [26p.] Order Number DE93631657. Source: OSTI; NTIS (US Sales Only); INIS.

To address the broad range of environmental issues in central and eastern Europe, including the former Soviet Union, the European Bank for Reconstruction and Development has adopted a twofold operational strategy: a regional programme approach and a project-based approach. The Bank is undertaking studies of environmental legislation and standards, and of training, liability and public participation requirements in the countries where it operates. It has also initiated environmental assessments in sectors where future investment projects are anticipated. The principal objectives of this work are to assist the countries of central and eastern Europe, those who wish to invest in these countries and Bank staff in their environmental appraisal work.

26417 (INIS-mf–13551) **Environmental management: The bank's policy approach.** European Bank for Reconstruction and Development, London (United Kingdom). 1992. [15p.] Order Number DE93631658. Source: OSTI; NTIS (US Sales Only); INIS.

In order to play a leadership role in the environmental recovery of central and eastern Europe, the Bank will pursue the following policy priorities: assistance to the countries of operations in environmental policy formulation, including the development of effective legal and regulatory instruments, the adoption of appropriate emissions and effluents standards and the creation of the institutional and human resources capacity to monitor and enforce them; promoting the use of a variety of economic instruments to address the underlying cause of environmental degradation and the adoption of market-based techniques in environmental management programmes; encouraging the development of an environmental goods and services industry in the countries of operations, of commercially viable investments in environmental technologies and pollution prevention and control, and by funding environmental infrastructure projects; initiation of, or support for, special studies and programmes to address regional and national environmental problems and to promote environmental education within the population and institutions of the countries of operations; adoption of adequate environmental assessment, management planning, audit and monitoring procedures throughout its activities; and promoting the adoption and implementation of procedures for provision of information to, and consultation with, all levels of government and the general public - especially potentially affected parties - concerning environmental matters.

26418 (NUTEK-R–92-43) **Electricity market under change: A study of electric power markets in Eastern Europe, CIS and the Baltic states.** Swedish National Board for Industrial and Technical Development (NUTEK), Stockholm (Sweden). Nov 1992. [92p.] (In Swedish). Order Number DE93631659. Source: OSTI; NTIS; INIS.

The electric power sector of the countries and their many problems are described. Statistical data on supply and demand pieces, primary energy use et cetera are given. A brief overview of the economical situation, and a discussion of nuclear power safety in the area are presented. (34 refs., 7 figs., 37 tabs.).

2903 Environment, Health, and Safety

Refer also to citation(s) 25814, 25858, 25859, 25869, 25900, 25984, 26033, 26034, 26035, 26036, 26037, 26111, 26219, 26413, 26416, 26417, 26457, 26459, 26462, 26474, 26481, 26537, 26545, 26546, 27319, 27331

26419 (ANL/ESH/CP–78719) **Integrating environment, safety and health training at a national laboratory.** Larson, D.R. Argonne National Lab., IL (United States). [1993]. 6p. Sponsored by

USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-930488–1: 10. symposium on training of nuclear facility personnel, Nashville, TN (United States), 25-29 Apr 1993). Order Number DE93009956. Source: OSTI; NTIS; INIS; GPO Dep.

In a multi-purpose research laboratory, innovation and creativity are required to satisfy the training requirements for hazards to people and the environment. A climate that encourages excellence in research and enhances hazard minimization skills is created by combining technical expertise with instructional design talent.

26420 (CONF-930276–Summ.) **Industry/Department of Energy workshop on chemical safety: Summary and highlights.** USDOE Assistant Secretary for Environment, Safety, and Health, Washington, DC (United States). Office of Deputy Assistant Secretary for Safety and Quality Assurance. May 1993. 46p. Sponsored by USDOE, Washington, DC (United States). From Department of Energy (DOE)/industry workshop on chemical safety; Germantown, MD (United States); 10-11 Feb 1993. Order Number DE93014702. Source: OSTI; NTIS; GPO Dep.

As part of the US Department of Energy (DOE) Office of Environment, Safety and Health (EH) oversight responsibilities under Secretary of Energy Notice 6D, the Office of Safety and Quality Assurance (EH-30) routinely evaluates the adequacy and effectiveness of line organization nonnuclear safety programs and processes, particularly where occupational safety can be affected. As a result of safety concerns raised in several forums, including Tiger Team Assessments and Technical Safety Appraisals, reviews of chemical incidents at DOE facilities, identification of safety issues by external DOE oversight organizations, and the EH oversight evaluation of Program Secretarial Officers' safety analysis programs, EH has determined that chemical safety is a key area requiring further evaluation. This workshop summary provides insight into the safety culture and management policies of leading US chemical companies. This summary also suggests some actions by the Department of Energy for improving its own safety activities. As part of the workshop, representatives of the chemical industry discussed the programs their companies have carried out to reduce or eliminate the use of highly hazardous chemicals as much as possible. The chemicals focused on for elimination or risk reduction included chlorine, ammonia, hydrogen fluoride, and sulfur dioxide.

26421 (CONF-930570–1) **Integrating Natural Resource Damage Assessment and environmental restoration activities at DOE facilities.** Bascietto, J.J. (Dept. of Energy, Washington, DC (US). RCRA/CERCLA Div.); Dunford, R.W.; Sharples, F.E.; Suter, G.W. II. Oak Ridge National Lab., TN (United States). [1993]. 34p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 2. annual Federal environmental restoration conference and exhibition; Washington, DC (United States); 25-27 May 1993. Order Number DE93015424. Source: OSTI; NTIS; GPO Dep.

Environmental restoration activities are currently under way at several sites owned by the US Department of Energy (DOE) under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended. DOE is the CERCLA lead response agency for these activities. Section 120(a) of the Superfund Amendments and Reauthorization Act also subjects DOE to liability under Section 107 of CERCLA for natural resource damages resulting from hazardous substance releases at its sites. The Natural Resource Damage Assessment (NRDA) process, by which natural resource injuries are determined and compensatory monetary damages are calculated, is not well known or understood by DOE staff and contractors involved in environmental restoration activities. Nevertheless, natural resource liabilities are potentially a significant source of additional monetary claims for CERCLA hazardous substance releases. This paper describes the requirements of NRDA and explains how to integrate the NRDA and CERCLA Remedial Investigation/Feasibility Study processes, in order to more quickly restore environmental services at the lowest total cost to the public. The first section of the paper explains the statutory and regulatory mandates for the NRDA process. The second section briefly describes the four phases of the NRDA process, while the third section examines the three steps in the assessment phase in considerable detail. Finally, the last section focuses on the integration of the CERCLA and NRDA processes.

26422 (DOE/EH–0322) **Environment, safety and health progress assessment of the Brookhaven National Laboratory (BNL).** USDOE, Washington, DC (United States). Feb 1993. 277p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93013900. Source: OSTI; NTIS; GPO Dep.

This report documents the result of the US Department of Energy (DOE) Environment, Safety and Health (ES&H) Progress Assessment of the Brookhaven National Laboratory (BNL) in Upton, New York. The initial site visit was conducted from December 8 through December 11, 1992, and the onsite assessment was conducted from January 25, 1993, through February 5, 1993. This Progress Assessment included a selective review of the ES&H management systems and programs with principal focus on the Office of Energy Research (ER), the Office of Science and Technology (ST), the Chicago Field Office (CH), the Brookhaven Area Office (BHO), and the site contractor, Associated Universities, Inc. (AUI). The ES&H Progress Assessments are a part of the DOE's continuing effort to institutionalize line management accountability and the self-assessment process throughout DOE and its contractor organizations. The purpose of the BNL ES&H Progress Assessment is to provide senior DOE management with an independent assessment of the adequacy and effectiveness of the DOE and contractor management structures, resources, and systems to address ES&H issues and requirements with the June 1990 Tiger Team Assessment of BNL as the baseline from which progress was measured.

26423 (DOE/ER/60759–T1) **Ecology for a changing earth: Final report.** Brown, J.H. (New Mexico Univ., Albuquerque, NM (United States)); Roughgarden, J. Stanford Univ., CA (United States). 6 Feb 1990. 17p. Sponsored by USDOE, Washington, DC (United States); National Science Foundation, Washington, DC (United States). DOE Contract FG03-89ER60759. Grant BSR-8821458. Order Number DE93016365. Source: OSTI; NTIS; INIS; GPO Dep.

To forecast the ecological impact of global change, research initiatives are needed on the explicit role of humans in ecological systems, and on how ecological processes functioning at different spatial and temporal scales are coupled. Furthermore, to synthesize the results of ecological research for Congress, policymakers, and the general public, a new agency, called the United States Ecological Survey (USES) is urgently required. Also, a national commitment to environmental health, as exemplified by establishing a National Institutes of the Environment (NIE), should be a goal.

26424 (DOE/FTR–93012248) **Radioactive waste management and environmental restoration issues in England: Foreign trip report, January 24–29, 1993.** Whitfield, R.P. (USDOE Assistant Secretary for Environmental Restoration and Waste Management, Washington, DC (United States)); King, W.H.H.; Adams, W.D.; Craig, J.R. Jr.; Whitfield, H.K.; Dyer, R.S. USDOE Assistant Secretary for Environmental Restoration and Waste Management, Washington, DC (United States). 26 Feb 1993. 8p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93012248. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The purpose of the trip was to gain an understanding of British regulations (and the evolution of these regulations) which permit recycling of previously radioactive-contaminated materials to the British economy; to review the British approach to the application of environmental regulations to nuclear cleanup activities; to observe the British method of communicating controversial information to the public; and to tour various facilities where radioactive waste management and environmental restoration activities are conducted.

26425 (ECE/ENVWA–30) **Contribution to the ministerial conference "environment for Europe", Lucerne, Switzerland, 28-30 April 1993. As adopted by the Senior Advisers to ECE Governments on Environmental and Water Problems on 19 March 1993.** United Nations Economic Commission for Europe (ECE), Geneva (Switzerland). 1993. [17p.] Order Number DE93630852. Source: OSTI; NTIS (US Sales Only); INIS.

The Ministerial Conference "Environmental for Europe", held in Dobris Castle in June 1991, underlined the need to develop an environmental programme for Europe which would serve as the framework for improved coordination of national and international

efforts in Europe. The Expert Group for the second Ministerial Conference "Environment for Europe", to be hosted by the Government of Switzerland in Lucerne from 28 to 30 April 1993, invited the Senior Advisers to propose initial elements for such a programme. The Senior Advisers were also invited to assess progress in the implementation of the conclusions and recommendations of the Bergen, Dublin and Dobris Conferences, to consider the relevant implications of the United Nations Conference on Environment and Development (UNCED), and to prepare draft elements for a Ministerial Declaration for the Lucerne Conference. The present document, prepared in the light of the discussions held and the various documents considered, was adopted by the Senior Advisers to ECE Governments on Environmental and Water Problems at their sixth session in Geneva, 16-19 March 1993 (ECE/ENVWA/29, para. 18).

26426 (ECE/ENVWA–30(add.1)) **Contribution to the ministerial conference "environment for Europe", Lucerne, Switzerland, 28-30 April 1993. Proposals for inclusion in the ministerial declaration: Transmitted by the Senior Advisers to ECE Governments on Environmental and Water Problems to the Expert Group for the Conference pursuant to the decision taken at their sixth session (ECE/ENVWA/29, para. 18).** United Nations Economic Commission for Europe (ECE), Geneva (Switzerland). 1993. [4p.] Order Number DE93630853. Source: OSTI; NTIS (US Sales Only); INIS.

Proposals for inclusion in the Ministerial Declaration, transmitted by the Senior Advisers to ECE Governments on Environmental and Wastes Problems to the Expert Group for the Conference pursuant to the decision taken at their sixth session in Geneva, 16-18 March 1993.

26427 (ETDE/JP-mf–93798681) **Symposium on global environmental conservation and air pollution prevention technology.** 20 Jan 1993. 94p. (In Japanese). Order Number DE93798681. Source: OSTI; NTIS; Available from The Society of Chemical Engineers, Japan, 6-19, Kohinata 4-chome, Bukyo-ku, Tokyo, Japan.

This paper states technologies for prevention of air pollution and CO2 separation/recovery in coal conversion and refuse incineration. For desulfurization in a coal fluidized bed combustor, Ca ion exchanged brown coal is used to increase efficiency and lower cost. In circulating fluidized bed combustion, a high desulfurization rate, 90%, is obtained even if the Ca/S ratio is 1. NOx emission behavior is grasped by chemical bond pattern of nitrogen in coal. Report is made on NOx and SOx emission behaviors in a 50MW fluidized bed demonstration boiler and a course of the measures taken. As to flue gas desulfurization/denitrification/dedusting, a semi-dry simplified desulfurizer, dry simultaneous desulfurization/denitrification by electron beams under coexistence with ammonia gas, etc. are described as technology directed to developing countries which are useful for energy conservation, agriculture and improvement of technical bases. The paper introduces prevention of dioxin emission in the dust collected by the refuse incinerating electrostatic precipitator and measures against NOx, HCl and mercury in flue gas. The developmental status of CO_2 absorption/separation, physical adsorption method, and membrane separation is described, but there are still a lot of technical and economical problems.

26428 (ETDE/JP-mf–93798681, pp. 1-6) **Global engineering of biology and air pollution.** Suzuki, M. (The University of Tokyo, Tokyo (Japan). Institute of Industrial Science). 20 Jan 1993. 94p. (In Japanese). In *Symposium on global environmental conservation and air pollution prevention technology.* Order Number DE93798681. Source: OSTI; NTIS (US Sales Only).

The environmental problem is posed by negative feedback which is imposed by the change in environment by human activity. The problem scalewise has a gradational structure from the molecular level to the global one and is extremely systematic. As chemical industry is good at having access to such a problem, necessity was pointed out of grasping the aspect of air pollution as generated and developed, composing its synthetic model of substance circulation and correctly comprehending the influence of each of all the factors. For example, the change in soil, vegetation, CO2 and other global systems is classified by a scale composed of time and space. As is the case with acid rain, necessity must be recognized of the ground on which the production, influence evaluation and control of causing substances can be studied through discussion on the same table. It is judged necessary to establish the method in which comprehension and future prediction of different phenomena can be made by a synthetic model taking the biological and oceanic functions into consideration as well as possible control of production mechanism from the human activity. 8 figs., 1 tab.

26429 (ETDE/JP-mf–93798681, pp. 66-74) **Foundation for CO2 separating and recovering technologies.** Nagahama, K. (Tokyo Metropolitan University, Tokyo (Japan)). 20 Jan 1993. 94p. (In Japanese). In *Symposium on global environmental conservation and air pollution prevention technology.* Order Number DE93798681. Source: OSTI; NTIS (US Sales Only).

CO2 causing global warming, discharged from general industries has relatively high concentration. This paper explains a phase equilibrium relation and its theory as the foundation for technologies to separate and recover mainly CO2. Separating and recovering technologies may include the following processes. A physical absorption process that dissolves gases under low temperatures and high pressures, followed by depressurization to regenerate the gas absorbed liquid. The process requires a partial gas pressure of more than several atmospheric pressures in the absorption stage, and has a problem of absorbing heavy hydrocarbon simultaneously. A chemical absorption process uses a reversible reaction with amines, for example, to perform an absorption at about 40°C and regenerate amine liquid at about 120°C. A distillation process has a difficulty in application because it requires subzero liquefaction, but has a possibility in the case where liquid CO2 is required. An adsorption process uses often a pressure swing method using zeolite or activated carbon. A membrane separation process is also available, but it requires a huge membrane area if a great amount of gas is to be treated. 5 refs., 7 figs., 6 tabs.

26430 (ETDE/JP-mf–93798681, pp. 75-80) **Current situation in CO2 absorbing and separating pilot plant.** Uchiyama, M. (The Tokyo Electric Power Co. Inc., Tokyo (Japan)). 20 Jan 1993. 94p. (In Japanese). In *Symposium on global environmental conservation and air pollution prevention technology.* Order Number DE93798681. Source: OSTI; NTIS (US Sales Only).

This paper describes the T electric power company's efforts to preserve global environment, taking a CO2 absorbing and separating pilot plant as a main example. Results of the past efforts in the electric utility industry to reduce CO2 emission are shown clearly in the annual change and figures per unit power generation amount for CO2 generation. However, further reduction in emission by 20% to 25% is required to achieve the agreement reached at the UN Environmental Development Conference to restore the CO2 emission level to that in 1990 by the end of the 1990's. Independent researches are being moved forward at each electric utility company. At T Company, indoor tests and bench scale experiments are continued, as well as a test on exhaust gases (containing CO2 at about 11%) from a coal burning boiler (with an output equivalent to 165 MW) using a pilot plant of the absorption process with a capacity of 1000 m^3N/h. Several kinds of absorbents were selected from among amine-based absorbents, which are subjected to the test sequentially. About 4.6 tons of CO2 can be recovered per day. Discussions will continue on different factors. 8 refs., 6 figs., 2 tabs.

26431 (ETDE/JP-mf–93798681, pp. 81-88) **Summary of PTSA-CO2 separating technologies.** Shibagaki, T. (Hokuriku Electric Power Co. Inc., Toyama (Japan)). 20 Jan 1993. 94p. (In Japanese). In *Symposium on global environmental conservation and air pollution prevention technology.* Order Number DE93798681. Source: OSTI; NTIS (US Sales Only).

Electric utility companies are moving forward researches on possibilities of CO2 separating technologies. This paper introduces a CO2 separating technology using a physical adsorption process and a PTSA-CO2 separating technology using a circulating fluidized bed system worked on by the H electric power company. A process to carry out adsorption under pressurization and desorption under depressurization is called a PSA process. A process to perform adsorption under low temperatures and desorption under high temperatures is called a TSA process. The PSA process has better economic effects and operability than the TSA process. However, because even the PSA process has technical and

economic problems in increasing capacities, a bench plant of circulating fluidized bed system (treating 2 m^3 per hour) was built newly to continue demonstration tests. This process desorbs zeolite particles having adsorbed CO2 using an adsorption riser under normal pressure by flowing and returning the particles into a desorption riser under depressurization. The process requires no such complex mechanism as a switching device and can be expanded easily. The test has come to a stage of having obtained results of circulating flow for 500 hours. 9 refs., 11 figs., 5 tabs.

26432 (ETDE/JP-mf–93798906) **Prospect on new energies.: Global warming.** Institute of Applied Energy, Tokyo (Japan). Mar 1991. 26p. (In Japanese). Order Number DE93798906. Source: OSTI; NTIS; Available from The Institute of Applied Energy, 14-2, Nishishinbashi 1-chome, Minato-ku, Tokyo, Japan.

This paper reports surveys on global warming carried out by the General Energy Engineering Research Institute of Japan. An international agreement has been reached on prohibiting manufacture of fluorocarbon that destructs the stratosphere. Fluorocarbon has an influence not only on ozone layer destruction, but also on global warming with an intensity next to CO2. Substitutive fluorocarbons are also demanded of a reivew in this point. The CO2 greenhouse effect is caused mainly from burning fossil fuels. An assumption of collecting, transporting, and treating half of the current annual discharge amount of 20 billion tons would involve an exorbitant amount of expense. There could no other ways but to suppress its use. Even converting fuels to natural gases and restricting use of fossil fuels may impose an immeasurable effect on the human society. No answer to this important problem has been presented because of complexity in the conditions of relevant countries, not to speak of that in developing countries. Efforts should be paid on solving the problems under international cooperations, and comprehensive strategies must be moved forward while determining changes in social and economic conditions. At the same time, consciousness of all of the people in the world on the problems is important. 8 refs., 12 figs., 2 tabs.

26433 (IEE-SR–239) **Analysis on factors affecting energy consumptions and CO2 emissions and their regional and sectoral differences.** Institute of Energy Economics, Tokyo (Japan). 1 Mar 1993. 244p. (In Japanese). Order Number DE93798888. Source: OSTI; NTIS; Available from The Institute of Energy Economics, Dai 10 Mori Biru, 18-1, Toranomon 1-chome, Minato-ku, Tokyo, Japan.

Regional and sectoral characteristics of energy consumption and CO2 emissions in different countries are clarified by constructing a framework for analysis which is common to both developed and developing countries. As a basis of the analysis, cases are estimated of maintaining/fixing the energy demand structure in 1973 and of maintaining the economic growth before 1973, and through comparisons with actual changes, optional effects of energy conservation, fuel conversion, etc. are comparatively analyzed in the framework common to each country. In developed countries economy has slowed down, and energy conservation and petroleum substitution have been promoted. Resultantly CO2 emission has been controlled. Energy conservation effects are large particularly in the industrial sector in Japan. In the former Soviet Union and East European countries where economy pattern is shifting, there are characteristically seen economic stagnation and lowered energy efficiency/energy inefficiency, which will cause the problems if the economy is irrationally activated. In developing countries, economy is growing and energy consumption is markedly increasing. There, more CO2 control measures should be taken. It is necessary to study option of CO2 emission control measures according to character of each country. 136 figs., 35 tabs.

26434 (NEDO-ITE–9111) **Survey of the present status of substances influencing the global environment (methane, freon and nitrous oxide) and the measures against them.** New Energy and Industrial Technology Development Organization, Tokyo (Japan). Mar 1992. 90p. (In Japanese). Sponsored by New Energy and Industrial Technology Development Organization, Tokyo (Japan). Order Number DE93799056. Source: OSTI; NTIS; Available from New Energy and Industrial Technology Development Organization, Sunshine 60, 30F 1-1, 3-chome, Higashi-Ikebukuro, Toshima-ku, Tokyo, Japan.

Following 1990, a survey is made on effects of methane, freon and nitrous oxide on the global environment. Besides arrangement of additional literature, the survey is conducted also on the measures taken from an industrial aspect. The present tackling with the environment problem on governmental and nongovernmental levels is described with regard mainly to the measures against global warming and destruction of ozone layer. With respect to CO2 which is a gas most responsible for the greenhouse effect, various studies are made at home and abroad, but CO2 measures are difficult to be taken in connection with economical development. Emission of other greenhouse effect gases like methane, freon and nitrous oxide has to be also reduced at the same time. Proposed are control of methane by development of paddy water management technique, control of nitrous oxide by improvement of fertilizer, and reduction of methane from livestock intestines by improvement of animal feed. It is effective to promote introduction of the technique of fluidized bed boilers to the coal-thermal power generation in developing countries. Measures against methane emitted from reclaimed sites are also mentioned. It is important to evaluate the measures against other substances affecting the environment as well as the above-mentioned gases and to integrate responsibility, burden and policy guidance. 37 refs., 13 figs., 14 tabs.

26435 (PSI–93-02) **The economics of global warming.** Pillet, G. (Paul Scherrer Inst. (PSI), Villigen (Switzerland)); Hediger, W.; Kypreos, S.; Corbaz, C. Paul Scherrer Inst. (PSI), Villigen (Switzerland). May 1993. [165p.] Order Number DE93631663. Source: OSTI; NTIS; INIS.

The global warming threat is challenging the world community to both international cooperation and national policy action. This report focuses on the necessity to alternate between "global and national climate policies". The Swiss perspective is at issue. The economic rationales for comparing national climate policy options are analyzed. This report explicitly focusses on the fundamental role of the normative framework and the related environmental-economic requisites for establishing an efficient national climate policy and computing a "carbon tax". Finally, the latest results of the energy and greenhouse gas scenarios for Switzerland, elaborated on within the network of the IEA/ETSAP Project, Annex IV, "Greenhouse Gases and National Energy Options: Technologies and Costs for Reducing Emissions of Greenhouse Gases", illustrate Switzerland's difficulties in reducing greenhouse gas emissions at "reasonable cost" compared with other countries. This should make Switzerland very sensitive to the implementation of efficient environmental-policy instruments and international cooperation. (author) figs., tabs., refs.

26436 (SAND–93-0466C) **Waste minimization/pollution prevention at R&D facilities: Implementing the SNL/NM Process Waste Assessment Program.** Kjeldgaard, E.A. (Sandia National Labs., Albuquerque, NM (United States)); Stermer, D.L.; Saloio, J.H. Jr.; Lorton, G.A. Sandia National Labs., Albuquerque, NM (United States). [1993]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-930483–8: 9. waste minimization and pollution prevention conference, San Francisco, CA (United States), 13-15 Apr 1993; TTC–1253). Order Number DE93012860. Source: OSTI; NTIS; INIS; GPO Dep.

The Sandia National Laboratories, New Mexico (SNL/NM) Process Waste Assessment (PWA) program began formally on November 2, 1992. This program represents the first laboratory-wide attempt to explicitly identify and characterize SNL/NM's waste generating processes for waste minimization purposes. This paper describes the major elements of the SNL/NM PWA program, the underlying philosophy for designing a PWA program at a highly diverse laboratory setting such as SNL/NM, and the experiences and insights gained from five months of implementing this living program. Specifically, the SNL/NM PWA program consists of four major, interrelated phases: (1) Process Definition, (2) Process Characterization, (3) Waste Minimization Opportunity Assessment, and (4) Project Evaluation, Selection, Implementation, and Tracking. This phased approach was developed to Provide a flexible, yet appropriate, level of detail to the multitude of different "processes" at SNL/NM. Using a staff infrastructure of approximately 60 Waste

Minimization Network Representatives (MinNet Reps) and consulting support, the SNL/NM PWA program has become the linchpin of even more progressive and proactive environmental, safety, and health (ES&H) initiatives such as: (1) cradle-to-grove material/waste tracking, (2) centralized ES&H reporting, and (3) detailed baselining and tracking for measuring multi-media waste reduction goals. Specific examples from the SNL/NM PWA program are provided, including the results from Process Definition, Process Characterization, and Waste Minimization Opportunity Assessments performed for a typical SNL/NM process.

26437 (TVA-Circ.–Z-321) **Some impacts of the 1990 Clean Air Act and state clean-air regulations on the fertilizer industry.** Breed, C.E.; Kerns, O.S. National Fertilizer and Environmental Research Center, Muscle Shoals, AL (United States). [1992]. 16p. Sponsored by Tennessee Valley Authority, Knoxville, TN (United States). (CONF-920815–23: 204. American Chemical Society (ACS) national meeting, Washington, DC (United States), 23-28 Aug 1992). Order Number DE93014197. Source: OSTI; NTIS; INIS.

The Clean Air Act amendments of 1990 will intensify national efforts to reduce air pollution. They will have major impacts on governmental agencies and on industrial and commercial facilities throughout the country. As with other industries, it is essential for fertilizer dealers and producers to understand how these changes to the Clean Air Act can significantly change the way they do business. This paper is proffered as an overview of ways in which the 1990 amendments to the Clean Air Act may impact the fertilizer industry. The nonattainment, toxics, and permit provisions of the amended act will be three areas of particular concern to the fertilizer industry. Implementation of the new regulatory requirements of this legislation promises to be a long and onerous process for all concerned. However, it appears that state and local regulations may have a much more profound impact on the fertilizer industry than the new Clean Air Act.

2904 Energy Resources

Refer also to citation(s) 26413

2905 Research, Development, Demonstration, and Commercialization

Refer also to citation(s) 26002, 26449, 26523, 26527, 26551, 26552, 26557, 26600, 27267, 28208

26438 (CONF-9305151–, pp. 7, Paper 9) **Academic freedom.** Padgett, K.M. (Los Alamos National Lab., NM (US)). USDOE Office of Administration and Management, Washington, DC (United States). [1993]. DOE Contract W-7405-ENG-36. From 15. computer security group training conference: mission possible - connected and protected; Albuquerque, NM (United States); 3-6 May 1993. In *Fifteenth Department of Energy Computer Security Group training conference: Mission possible: Connected and protected.* 244p. Order Number DE93011853. Source: OSTI; NTIS.

The American Heritage Dictionary defines Academic Freedom as "Liberty to pursue and teach relevant knowledge and to discuss it freely without restriction from school or public officials or from other sources of influence." In its untarnished form, academic freedom means that a researcher is free to pursue his research without political interference from the academic bureaucracy. This article discusses how the practice of research laboratories doing research for the business community as well as hiring Washington lobbyists to get appropriations has generated a conflict of interest in research. The author proposes that academic freedom is a complex idea when utilised by research laboratories that can no longer pursue purely academic research. The dangers of present-day research posed by perceptions of what is ethical in the laboratory environment are explored. 2 refs.

26439 (DOE/FTR–93011657) **A trip to Hungary to present a paper on bioremediation and to attend the international symposium on environmental contamination in central and eastern Europe: Foreign trip report, October 10–October 19, 1992.** Leo, A.T. Sandia National Labs., Livermore, CA (United States). 4 Nov 1992. 34p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DR00789. Order Number DE93011657. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The purpose of this trip was to participate in a forum for the transfer and exchange of technologies are applicable in addressing the near-term and long-term environmental needs of Central and Eastern Europe countries. The major emphasis was on identifying and assessing technology transfer and exchange opportunities. Sandia presented a paper: A Systematic Approach for the Design and Application of in Situ Bioremediation. Only limited, informal, contacts with other participants were made.

26440 (NUTEK-B–93-1) **IEA Bioenergy. Annual report 1992.** Swedish National Board for Industrial and Technical Development (NUTEK), Stockholm (Sweden). 1993. 67p. Order Number DE93500865. Source: OSTI; NTIS.

At the end of 1992 fifteen countries or organisations participated in the collaboration on Bioenergy: Austria, Belgium, Canada, Denmark, Finland, Italy, Japan, Netherlands, New Zealand, Norway, Sweden, Switzerland, United Kingdom, United States and CEC. There are four Task Annexes to the Implementing Agreement the period 1992-94: Efficient and Environmentally-Sound Biomass Production Systems; Harvesting and Supply of Woody Biomass for Energy; Biomass Utilization; and The Conversion of Municipal Solid Waste Feedstock to Energy. The achievements from the old Tasks are summarized, and information on the content and progress of the new Tasks are given in this report, as well as lists of published articles and reports.

2906 Nuclear Energy

Refer also to citation(s) 25887, 26166, 26214, 26218, 26329, 26408, 26412, 26464, 26465, 26471

26441 (IAEA-TECDOC–696, pp. 53-60) **Opinion polls and marketing trials with irradiated food.** Loaharanu, P. (Joint FAO/IAEA Div. of Nuclear Techniques in Food and Agriculture, Vienna (Austria)). World Health Organization, Manila (Philippines). Regional Office for the Western Pacific; Joint FAO/IAEA Div. of Nuclear Techniques in Food and Agriculture, Vienna (Austria). Mar 1993. (CONF-9201151–: WHO/IAEA/FAO seminar on harmonization of regulations on food irradiation in Asia and the Pacific, Kuala Lumpur (Malaysia), 20-24 Jan 1992). In *Harmonization of regulations on food irradiation in Asia and the Pacific: Proceedings of a seminar held in Kuala Lumpur, Malaysia, 20-24 January 1992.* [211p.] Order Number DE93629035. Source: OSTI; NTIS (US Sales Only); INIS.

There is a widely held perception among policy makers, food industries and some governments that consumers would be reluctant to accept irradiated food. This opinion has given opposition groups the basis upon which to make the further claim that consumers would reject such food. Indeed, some opinion polls conducted in some Western countries tend to support this claim. It should be noted that these polls were conducted in countries where no irradiated food was available at the retail level. It is clear from these polls that the majority of consumers had never heard of food irradiation much less knew the benefits which they may expect from it. Initially, most consumers appeared to confuse irradiated food with food contaminated with radionuclides (radioactive food). However, when provided with factual information on food irradiation, higher percentages of consumers appeared to be more willing to buy irradiated food. The situation was quite different when marketing trials of irradiated food were conducted in several countries in the past 5 years, often at the place where non-irradiated food of the same kind were available. These trials conducted in countries such as France, U.S.A., Bangladesh, China, Philippines and Thailand showed that, when consumers had informed choices, they preferred to buy irradiated food, probably on the basis of their higher quality or perceived greater safety. Details of marketing trials of different irradiated food items conducted in the past 5 years will be described. (author). 21 refs, 1 tab.

26442 (IAEA-TECDOC–696, pp. 163-169) **Acceptance of food irradiation by the consumer - The views of consumers.** Beishon, J. (International Organization of Consumers Union (Netherlands)). World Health Organization, Manila (Philippines).

Regional Office for the Western Pacific; Joint FAO/IAEA Div. of Nuclear Techniques in Food and Agriculture, Vienna (Austria). Mar 1993. (CONF-9201151–: WHO/IAEA/FAO seminar on harmonization of regulations on food irradiation in Asia and the Pacific, Kuala Lumpur (Malaysia), 20-24 Jan 1992). In *Harmonization of regulations on food irradiation in Asia and the Pacific: Proceedings of a seminar held in Kuala Lumpur, Malaysia, 20-24 January 1992.* [211p.] Order Number DE93629035. Source: OSTI; NTIS (US Sales Only); INIS.

The International Organization of Consumers Union (IOCU) remains opposed to the wider use of irradiation in food processing, and has yet to be convince that all the long-term safety concerns have been addressed. It remains skeptical, as do consumers generally, that food irradiation is being promoted primarily in the public interest rather than in the interests of other parties. It remains concerned about the monitoring, control and prevention of abuse of the process. Those promoting irradiation should satisfy the genuine and legitimate concerns of IOCU and consumers worldwide; they are still some way from achieving this.

26443 (IAEA-TECDOC–696, pp. 171-174) **Acceptance of food irradiation by the consumer - A critical review of typical misconceptions.** Tape, N. World Health Organization, Manila (Philippines). Regional Office for the Western Pacific; Joint FAO/IAEA Div. of Nuclear Techniques in Food and Agriculture, Vienna (Austria). Mar 1993. (CONF-9201151–: WHO/IAEA/FAO seminar on harmonization of regulations on food irradiation in Asia and the Pacific, Kuala Lumpur (Malaysia), 20-24 Jan 1992). In *Harmonization of regulations on food irradiation in Asia and the Pacific: Proceedings of a seminar held in Kuala Lumpur, Malaysia, 20-24 January 1992.* [211p.] Order Number DE93629035. Source: OSTI; NTIS (US Sales Only); INIS.

New technologies are becoming increasingly difficult to introduce. Consumers are concerned about new technologies; they are more aware of mistakes made in introducing them and, therefore, have become apprehensive, particularly regarding food preservation techniques. However, it is enlightening to compare the problems faced today with food irradiation with those experienced several decades ago during the commercialization of pasteurization. Many of the objections to the two preservation processes are identical - e.g. an excuse for the sale of "dirty" food; takes the "life" out of food; diminishes the nutritive value; favours the growth of harmful bacteria; increases food prices. Consumer concerns on food irradiation focus on safety, wholesomeness, cost benefit, information and freedom of choice. In many countries, as well as internationally, consumer organizations are invited to participate in deliberations on food research, food standards and the regulation of new technologies, including food irradiation. Such consultation will be time consuming, but will lead to greater consensus on commercialization of food technologies and the necessary controls. The food irradiation consensus document, elaborated at the 1988 International Conference on "Acceptance, Control of and Trade in Irradiated Food", describes several actions required to achieve consumer acceptance. Better public information was underlined at the Conference. To date, consumer acceptance, has been based primarily on consumer research polls. However, marketing trials are a better indicator of acceptance since consumers can experience the benefits of irradiation - e.g. better flavour, longer storage. Marketing trials over the past seven or eight years in many countries have demonstrated that consumers, when given a choice, will purchase irradiated foods. (author). 7 refs.

26444 (IAEA-TECDOC–696, pp. 175) **Acceptance of food irradiation by the food industry - Problems and prospects.** Tape, N. World Health Organization, Manila (Philippines). Regional Office for the Western Pacific; Joint FAO/IAEA Div. of Nuclear Techniques in Food and Agriculture, Vienna (Austria). Mar 1993. (CONF-9201151–: WHO/IAEA/FAO seminar on harmonization of regulations on food irradiation in Asia and the Pacific, Kuala Lumpur (Malaysia), 20-24 Jan 1992). In *Harmonization of regulations on food irradiation in Asia and the Pacific: Proceedings of a seminar held in Kuala Lumpur, Malaysia, 20-24 January 1992.* [211p.] Order Number DE93629035. Source: OSTI; NTIS (US Sales Only); INIS.

Regulatory and safety aspects of the process, equipment, and cost factors, as well as obtaining consumer acceptance are factors which have contributed to the slowness of the commercialization of food irradiation. But there are still other factors equally important in determining the rate of commercialization. They are the pragmatic questions asked by food processors themselves. Will irradiation serve my particular needs? How much will it cost? Is it safe for consumer, customers and employees? What regulations will apply and how much will they cost me? What public relations aspects, including local community attitudes, will I need to address? What will consumers think of my product and how can I find out in advance? What liability issues are involved and are they greater or less than existing ones? Response to these questions will vary considerably. The benefits must be large indeed, if existing capital investment in competitive technology is to be replaced by irradiation. The marketplace does not embrace expensive changes easily or rapidly. Situations in which irradiation may compete are those where there are few established competitive processes, where irradiation provides a unique advantage, where existing processes are inadequate or old, or where a less energy intensive process is required. (author). (abstract only).

26445 (IAEA-TECDOC–697, pp. 19-22) **The energy dilemma.** Hatcher, S.R. (Atomic Energy of Canada Ltd., Ottawa, ON (Canada)). International Atomic Energy Agency, Vienna (Austria). Apr 1993. (CONF-9204252–: Technical committee meeting on fission gas release and fuel rod chemistry related to extended burnup, Pembroke (Canada), 28 Apr - 1 may 1992). In *Fission gas release and fuel rod chemistry related to extended burnup: Proceedings of a technical committee meeting held in Pembroke, Ontario, Canada, 28 April - 1 May 1992.* [235p.] Order Number DE93628297. Source: OSTI; NTIS (US Sales Only); INIS.

In his opening address Mr. Hatcher, President and Chief Executive Officer, Atomic Energy of Canada Limited considers different economical, social and environmental aspects of 'energy dilemma' which presents huge energy demands on the one hand and concerns about a healthy environment on the other hand.

26446 (IAEA-TECDOC–701) **Nuclear and conventional baseload electricity generation cost experience.** International Atomic Energy Agency, Vienna (Austria). Apr 1993. [63p.] Order Number DE93629794. Source: OSTI; NTIS (US Sales Only); INIS.

The experienced costs of electricity generation by nuclear and conventional plants and the expected costs of future plants are important for evaluating the economic attractiveness of various power projects and for planning the expansion of electrical generating systems. The main objective of this report is to shed some light on recent cost experience, based on well authenticated information made available by the IAEA Member States participating in this study. Cost information was provided by Canada (Ontario Hydro), Czechoslovakia, Hungary, India, the Republic of Korea and Spain. Reference is also made to information received from Brazil, China, France, Russia and the United States of America. The part of the report that deals with cost experience is Section 2, where the costs of both nuclear and fossil fired plants are reviewed. Other sections give emphasis to the analysis of the major issues and relevant cost elements influencing the costs of nuclear power plants and to a discussion of cost projections. Many of the conclusions can also be applied to conventional plants, although they are usually less important than in the case of nuclear plants. 1 ref., figs and tabs.

26447 (PSI–124) **Reactors 2000: consultation on the technical and economical requirements connected with the possible realization of nuclear installations in Switzerland after the year 2000: Report of the committee.** Haldi, P.A. (ed.) (Paul Scherrer Inst. (PSI), Villigen (Switzerland)). Paul Scherrer Inst. (PSI), Villigen (Switzerland). Jul 1992. [178p.] (In French). Order Number DE93629799. Source: OSTI; NTIS; INIS.

In 1989 the OECD started a consultation on the development of nuclear reactors of small and medium size (SMR). The present study is part of the Swiss contribution to this international work. Beyond this primary goal, without being limited solely to SMRs, but exclusively in the Swiss framework, the study attempts to determine a profile for reactors which could be built in Switzerland after the year 2000. The study "Reactors 2000" is based on two polls which were conducted among about 70 persons from concerned

professional circles (industry, utilities, scientific groups, energy policy makers, safety authorities, public organizations) in June 1990 and February 1991. A large majority of the persons interviewed think that - Switzerland should not jeopardize its energetic future by phasing out all activity in the nuclear field, based on circumstances which could be only temporary, - Switzerland should continue its activities in the nuclear field in order to maintain the necessary know-how and a sufficient number of highly qualified specialists both for the safe operation of the existing plants and for the continuation of the development of nuclear technology, - for future plants the goal of an even higher safety level should be aimed for, although, according to the explicit comments of many interviews, today's reactors are considered to be sufficiently safe, - future nuclear power plants should be designed in such a way that the possibility of a severe accident necessitating an evacuation of the Swiss population could be excluded, - Switzerland should participate in international projects, in order to maintain contact to the international development of nuclear technology; on the other hand, it should avoid any single-handed effort (including in the domain of small heating reactors). (author).

2908 Heat Utilization

Refer also to citation(s) 25971, 26820

26448 (VF-UB–93-3) **Biofuel-fired electricity and heat generation in a large district heating system - system studies using the Martes energy system model.** Ryding, B. Vattenfall AB, Vaellingby (Sweden). Jan 1993. 53 p.p. (In Swedish). Order Number DE93500935. Source: OSTI; NTIS; INIS.

The aim of the present study was to study the possibilities of introducing biofuel-fired co-generation of heat and electricity in the Umeaa district heating system. The study was conducted using the Martes energy system model. Results obtained and conclusions reached should also be of interest for other district heating systems. The annual cost of heat production for district heating with and without biofuel-fired cogeneration of heat and electricity was studied for the period 1992 until 2012. Two types of biofuel-fired cogeneration of heat and electricity were studied. One used only biofuel whereas the other used both biofuel and domestic waste. Initially, the cost was lowest for the system used at present in Umeaa, i.e., without simultaneous cogeneration of heat and electricity. After 1994, however, the district heating system with cogeneration of heat and electricity using only biofuel has the lowest cost. The assumed development of the electricity price is of great importance for the competitive ability of cogeneration of heat and electricity. The greater the capacity for electricity, the more it will benefit from a high price of electricity. The study was conducted using data considered to be reasonable in the future. Assessments made on future developments are, however, very difficult since there are numerous factors involved. Sensitivity studies of parameters considered to be of greatest importance for the competitive ability of cogeneration of heat and electricity need to be further studied. These are energy taxation and environmental tariffs, as well as the development of the prices of fuel and electricity. (52 refs., 19 tabs.).

2910 Conservation

Refer also to citation(s) 26412, 26472, 26475, 26505, 26509, 26554, 26557

26449 (ENEA-RT-INN–92-18) **NORME: Multi-media information system in support of technology utilization and transfer Italian program guidelines for financial assistance.** Gandini, A.G.; Bargellini, M.L.; Fontana, F.; Lo Tenero, B.; Ponzelli, E.; Dell'Universita, F. ENEA, Casaccia (Italy). Area Energia e Innovazione. May 1992. 50p. (In Italian). (RT/INN–92-18). Order Number DE93799210. Source: OSTI; NTIS (US Sales Only).

This module describes the information system, 'Norme', a support to industries (enterprises). This multi-media system contains all the information about the financial facilities and incentives supporting innovation (technology utilization and transfer, especially with regard to energy conservation) which are offered by Italian national, regional and provincial laws. It describes the conceptual and physical structure of the informative system, the typology of the data and functions.

26450 (ENEA-RTI-STUDI-ENE–92-02) **MePER (Methodology in support of Regional Energy Programming) sample survey and requests for participation in Piemonte Region energy conservation assistance programm (law No. 308/82).** D'Aguanno, C. ENEA, Casaccia (Italy). 1992. 58p. (In Italian). (RTI/STUDI-ENE–92-2). Order Number DE93799204. Source: OSTI; NTIS (US Sales Only).

The ENEA (Italian Agency for New Technology, Energy and the Environment) MePER (Methodology in support of Regional Energy Programming) support information system for Italian regional energy balance assessments allows energy planners to obtain a clear picture of sectoral energy efficiency trends and requirements. This paper compares MePER information on the energy supply and demand situation in the industrial sector of the Region of Piemonte with statistical information based on requests by local industrial firms for financial assistance in the implementation of energy conservation interventions. The mechanics of this assistance follows the provisions of Italian energy conservation Law No. 308/82. The aim of this comparative study is to identify areas for possible improvements with regard to effective energy conservation, reveal industrial energy consumption trends, and to gauge the effectiveness of MePER as a functional tool suitable for real time regional energy program management.

26451 (ETDE-IT–93-174) **Public intervention in promotion of energy conservation and in development of renewable energy resources: Italian experience.** D'Angelo, E.; Romerio, R. ENEA, Rome (Italy). Direzione Studi. 1992. 22p. (CONF-920906–4: 15. congress of the World Energy Council (WEC): energy and life, Madrid (Spain), 20-25 Sep 1992). Order Number DE93799193. Source: OSTI; NTIS (US Sales Only).

In Italy, a law passed in 1982 provided financial incentives for energy saving and the development of renewable energy resources. The incentives are administered partly by the Ministry of Industry and partly by the regional governments. This was the first time the Government had turned to financial incentives and regional decentralization to reduce energy consumption and increase the use of renewable sources in the industrial, residential and agricultural sectors. Following an initial period of inevitable legal, regulatory, administrative and technical problems, the law has been widely applied; of the many projects submitted, a great many, mainly in the industrial sector, have received funding from both the Ministry and the Regions. A quantitative assessment shows that in terms of actual energy savings, the results appear significant and encouraging, though it must be pointed out that the assessment was based on design data for projects that have been approved and funded, not completed projects. No less important than the quantitative results is the progress made in decentralizing decision-making in the field of energy. This process, initiated by the 1982 law, was confirmed by a statute passed last year which streamlines the procedures for approving projects and disbursing funds.

26452 (LBL–31469) **Analysis of federal policy options for improving US lighting energy efficiency: Commercial and residential buildings.** Atkinson, B.A.; McMahon, J.E.; Mills, E.; Chan, P.; Chan, T.W.; Eto, J.H.; Jennings, J.D.; Koomey, J.G.; Lo, K.W.; Lecar, M.; Price, L.; Rubinstein, F.; Sezgen, O.; Wenzel, T. Lawrence Berkeley Lab., CA (United States). Dec 1992. 346p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. Order Number DE93015281. Source: OSTI; NTIS; GPO Dep.

The US Department of Energy (DOE) has recognized the opportunity to achieve energy, economic, and environmental benefits by promoting energy-efficient lighting through federal policies, including lighting standards, financial incentives, and information programs. To assist in this process, the Office of Conservation and Renewable Energy's Office of Codes and Standards invited Lawrence Berkeley Laboratory to assess prospective national impacts for a variety of policy options. Some progress has already been made in developing lighting policies at both the federal and state levels. The US DOE's Office of Building Technologies has evaluated lighting efficiency incentives as part of its analysis for the National Energy Strategy. Fluorescent and incandescent lamp

standards are included in the national Energy Policy Act of 1992 (P.L. 102-486, October 24, 1992). A few states have analyzed or implemented lamp and luminaire standards. Many policy-related issues merit further investigation. For example, there is considerable debate over issues such as mandatory or voluntary standards versus component labeling and other education-oriented strategies. Several different technologies are involved that interact with each other-lamps (incandescent, compact fluorescent, and HID), ballasts (for fluorescent and HID lamps), and fixtures with reflectors and lenses. Control systems and operation patterns must also be considered (timers, automated dimming, or occupancy sensors). Lighting applications are diverse, ranging from offices, restaurants, hallways, hospital operating rooms, to exterior lights. Lighting energy use influences heating and cooling requirements in buildings. Successful lighting system design must also address interactions between architectural design elements and daylighting availability. Proper system installation and ongoing operation and maintenance are crucial. The economic aspects of the preceding points must also be considered for policy making.

2920 Supply, Demand, and Forecasting

Refer also to citation(s) 26408, 26450, 26458, 26460, 26466, 26471, 26474

26453 (DOE/EIA–0202(93/2Q)) **Short-term energy outlook quarterly projections: Second quarter 1993.** USDOE Energy Information Administration, Washington, DC (United States). Office of Energy Markets and End Use. 6 May 1993. 39p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93013134. Source: OSTI; NTIS; GPO; GPO Dep.

Energy markets are influenced by world oil prices, macroeconomic growth, and weather. This report focuses on the influence of these assumptions on energy supply, demand, and prices in the United States and other major energy-consuming countries.

26454 (NEDO-P–9129, pp. 11-142) **Field survey of information on energy policy in the Pacific region.: China as a whole.** New Energy and Industrial Technology Development Organization, Tokyo (Japan). Mar 1992. (In Japanese). In *Field survey of information on energy policy in the Pacific region.* 205p. Order Number DE93799052. Source: OSTI; NTIS.

Report is made on results of a survey on the energy situation in China. This paper relates to the whole of China, and separate papers deal with the regions of Central China and East China. The basic target of China is elasticity coefficients of primary energy more than 0.5 and those of electric power more than 0.1. In 1990, the latest year of the 7th 5-year plan, production of primary energy attained the target: 1.08 billion tons in raw coal which is 9% over the target, 138 million tons in crude oil, and 15.2 billion m^3in natural gas. The generated energy from the hydroelectric and thermal power generation attained 618 billion kWh which is 12.3% over the target. Coal reserve is 4 trillion tons within the depth of 1500m. The total oil resource in the inland and continental shelfs is 33 trillion m^3. It is presently urgent to develop more electric power because of its shortage. Development and promotion is planned to be made also of the nuclear power generation and the new energy power generation. 23 figs., 46 tabs.

26455 (NEDO-P–9129, pp. 143-168) **Field survey of information on energy policy in the Pacific region.: Central China region (Provinces of Henan, Hubei, Hunan and Jianxi).** New Energy and Industrial Technology Development Organization, Tokyo (Japan). Mar 1992. (In Japanese). In *Field survey of information on energy policy in the Pacific region.* 205p. Order Number DE93799052. Source: OSTI; NTIS.

The paper reports the results of a survey of the energy situation of the Central China region. The population of the region is 231.62 million. The installed capacity of the Central China power network is 20.29 million kW. About 80% of the power consumption are for the industrial use. On completion of Sanhsia Dam in the Sanhsia development plan, the reservoir capacity will be 30.3 billion m^3, the world's largest scale. On completion of Sanhsia hydroelectric power plant (18-year construction period), generated energy to be obtained will be 17.68 million kW (26 units x 680,000 kW), the world's largest scale. Annual generated energy in all China will reach 1.2 trillion kWh in 2000, and among them demand in Central and East China regions is 384 billion kWh in expectation of an increase of approximately 200 billion kWh during the 1990-2000 term. The effect of power generation at Sanhsia power plant is considerable since their annual generated energy is 67.7 billion kWh in a plan by the water reservoir level of 150m and 94.8 billion kWh in a plan by that of 180m. The total investment made in the Sanhsia project is expected to be over 100 billion gen. 7 figs., 7 tabs.

26456 (NEDO-P–9129, pp. 169-181) **Field survey of information on energy policy in the Pacific region.: East China region (Shanghai city, provinces of Zhejiang, Jiangsu and Anhui).** New Energy and Industrial Technology Development Organization, Tokyo (Japan). Mar 1992. (In Japanese). In *Field survey of information on energy policy in the Pacific region.* 205p. Order Number DE93799052. Source: OSTI; NTIS.

The paper reports the results of a survey of the energy situation of the East China region. The population of the region is 180 million. Electric power consumption is 109.7 billion kWh, 85.6% of which are for the industrial use. The maximum power has a feature of 'peak in summer'. The installed capacity with more than 500kW in the East China power network totals 22.13 million kW in 1990, 89% of which are the thermal power generation. Among three provinces and one city to be supplied, Shanghai city has only thermal power plants. The installed capacity of thermal power plants is 1,625,000kW in Jianbi which is the largest, 1,300,000kW in Xuzhou and 1,200,000kW in Shidongkou No.2 plant. The generated energy in the East China power network in 1990 totals 109.1 billion kWh, 95.4% of which are occupied by the thermal power generation. The installed capacity of thermal power plants shows an increase of 11.2% during implementation of the 7th 5-year plan. The number of a hydroelectric power plant with more than 150,000kW is five. The capacity of hydroelectric power generation is 2.44 million kW which is 11% of the East China power network. 1 fig., 4 tabs.

2930 Policy, Legislation, and Regulation

Refer also to citation(s) 25869, 26213, 26215, 26463, 26542

26457 (IEE-SR–240) **Status-quo of energy-related taxation systems in developed countries and economic instrumets for environmental preservation.** Institute of Energy Economics, Tokyo (Japan). 1 Mar 1993. 401p. (In Japanese). Order Number DE93798889. Source: OSTI; NTIS; Available from The Institute of Energy Economics, Dai 10 Mori Biru, 18-1, Toranomon 1-chome, Minato-ku, Tokyo, Japan.

Energy-related taxation systems in developed countries are investigated including moves toward introduction of environmental taxes to energy. The energy taxation system has become substantial in the public finance in which taxes are shifting from direct to indirect ones. Energy consumption tax revenues in the U.S. and Europe form a half of the specific consumption tax receipts. Patterns of energy taxation, which is mainly for transportation use fuel, are largely different in country. In North European countries introduction of the carbon tax was reported one after another from 1990 to 1991. The introduction was conducted in a trend of strengthening of the indirect tax and is ranked as an economic means to internalize the external environmental cost. EC proposes an environmental tax which mixes the energy tax and the carbon tax at the 1:1 ratio as one of the policies to stably keep CO2 emission in 2000 at the same level as in 1990. Circumstances in each country on the internationally common environmental tax, which also aims at securing funds for developing countries, are complicated, and therefore it is necessary to have discussions fully considering international cooperation. 101 figs., 109 tabs.

26458 (NEDO-P–9129) **Field survey of information on energy policy in the Pacific region.** New Energy and Industrial Technology Development Organization, Tokyo (Japan). Mar 1992. 205p. (In Japanese). Sponsored by New Energy and Industrial Technology Development Organization, Tokyo (Japan). Order Number DE93799052. Source: OSTI; NTIS; Available from New Energy and Industrial Technology Development Organization, Sunshine 60, 30F 1-1, 3-chome, Higashi-Ikebukuro, Toshima-ku, Tokyo, Japan.

As a part of the survey of energy policy information in the Pacific region, report is made mainly on the electric power supply situation in China. The generated power showed a 7.5% growth in the 1980s and was 137,890MW in power plant capacity and 621.3 billion kWh in generated energy in 1990. Electric power consumption is 78.7% of the total consumption in the whole industry, and per capita consumption is 526 kWh. Among the total power plant capacity of thermal and hydroelectric power generation, the thermal power generation shows 73.9% and hydroelectric 26.1%. In a 10 year plan until 2000, power sources which can provide more than 10,000 MW/year are planned to be newly installed and to be comprised of coal-fired (63%), hydroelectric (30%), nuclear (3%) and oil-fired (4%) power generation. Coal has already been used mostly as a substitute of petroleum. Power generation of renewable energy such as wind, geothermal and photovoltaic energy has been developed along with a small hydroelectric power generation to promote electrification in remote areas. Measures to be taken for the environmental policy have been delayed because of a lack of funds though necessity of the policy is admitted. Damages by acid rain are reported. 34 figs., 63 tabs.

26459 (NEI-DK–1193) **Duties as instruments of control: Incitements of duties payment and taxation conditions related to road transport.** Cowiconsult Raadgivende Ingenioerer A/S, Lyngby (Denmark). Feb 1993. 62p. (In Danish). Order Number DE93500106. Source: OSTI; NTIS.

In relation to Danish governmental efforts to reduce energy consumption and negative environmental impacts originating from the transportation sector, a number of suggestions have been presented. Interest has increased in economical control. The aim was to describe (qualitatively) the current duty and taxation structure and identify possible faults in this structure which could relate to incitements to save energy and reduce pollution. Possible changes in the system are discussed in relation to private cars, vans and lorries. The analysis is based on calculations of annual consumer costs for the use of the various vehicles in order to be able to make comparisons possible, also to total consumer costs. The results can be summarized by giving attention to how the various duties and taxes influence people's decisions on whether to purchase a vehicle, the choice of which type of vehicle to buy, and how this will influence the total volume of traffic. (AB).

2940 Fossil Fuels

Refer also to citation(s) 26408, 26412, 26453, 26464, 26465, 26471

26460 (DOE/EIA–0484(93)) **International energy outlook, 1993.** USDOE Energy Information Administration, Washington, DC (United States). Office of Integrated Analysis and Forecasting. 21 Apr 1993. 42p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93012998. Source: OSTI; NTIS; INIS; GPO; GPO Dep.

This report presents the current Energy Information Administration (EIA) assessment of the long-term outlook for international energy markets. This and other EIA reports are provided as a statistical service for use by managers and international energy analysts, not as a Government energy plan. Current US Government policies and foreign government policies are assumed to hold over the projection interval, which extends to the year 2010.

26461 (PSI–93-03) **Photochemical modelling of photo-oxidant levels over the Swiss plateau and emission reduction scenarios.** Rosselet, C.M. (Paul Scherrer Inst. (PSI), Villigen (Switzerland)); Kerr, J.A. Paul Scherrer Inst. (PSI), Villigen (Switzerland). May 1993. [175p.] Order Number DE93630827. Source: OSTI; NTIS; INIS.

During summertime high pressure conditions, high photo-oxidant (O_3, H_2O_2, PAN and others) levels are frequently observed in the planetary boundary layer in central Europe. It is well known that close to the earth's surface ozone is formed by complex reactions involving VOC, NO_x, and sunlight. Substantial reductions of both precursors are needed to reduce photo-oxidant levels. In this context the reductions of the abundance of the precursors and the variation of their ratios is of great importance. Here we report model calculations from the Harwell Photochemical Trajectory Model of the levels of O_3, H_2O_2 and PAN along a trajectory over the Swiss Plateau from Lake Constance to Lake Geneva. These calculations are in satisfactory agreement with measurements made during the intensive observation period of the research program POLLUMET (Pollution and Meteorology in Switzerland). Sensitivity calculations of emission reduction scenarios indicate that on the Swiss Plateau the ozone production may be mainly NO_x-limited; under conditions where the CO levels are closer to the upper limit within the range (120-600 ppbv). The calculated peak ozone level reduction caused by an exclusive NO_x-emission reduction is about three times larger than that caused by an exclusive VOC reduction. The combined reduction of all precursor compounds is the most efficient strategy, although it is only marginally more efficient than the NO_x-reduction scenario alone. (author) figs., tabs., 75 refs.

2950 Hydrogen and Synthetic Fuels

Refer also to citation(s) 25924

2960 Electric Power

Refer also to citation(s) 26111, 26113, 26400, 26408, 26412, 26446, 26453, 26471, 26473, 26509

26462 (ANL/EAIS–4) **Impact on the steam electric power industry of deleting Section 316(a) of the Clean Water Act: Capital costs.** Veil, J.A. Argonne National Lab., IL (United States). Environmental Assessment and Information Sciences Div. Jan 1993. 29p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. Order Number DE93011233. Source: OSTI; NTIS; INIS; GPO Dep.

Many power plants discharge large volumes of cooling water. In some cases, the temperature of the discharge exceeds state thermal requirements. Section 316(a) of the Clean Water Act (CWA) allows a thermal discharger to demonstrate that less stringent thermal effluent limitations would still protect aquatic life. About 32% of total US steam electric generating capacity operates under Section 316(a) variances. In 1991, the US Senate proposed legislation that would delete Section 316(a) from the CWA. This study, presented in two companion reports, examines how this legislation would affect the steam electric power industry. This report describes alternatives available to nuclear and coal-fired plants currently operating under variances. Data from 38 plants representing 14 companies are used to estimate the national cost of implementing such alternatives. Although there are other alternatives, most affected plants would be retrofitted with cooling towers. Assuming that all plants currently operating under variances would install cooling towers, the national capital cost estimate for these retrofits ranges from $22.7 billion to $24.4 billion (in 1992 dollars). The second report quantitatively and qualitatively evaluates the energy and environmental impacts of deleting the variance. Little justification has been found for removing the Section 316(a) variance from the CWA.

26463 (DOE/CH/10093–125) **Office of Utility Technologies success stories.** National Renewable Energy Lab., Golden, CO (United States). Mar 1993. 28p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-83CH10093. Order Number DE92001193. Source: OSTI; NTIS; GPO Dep.

In the National Energy Strategy the Department of Energy (DOE) projected that even with aggressive conservation and efficiency efforts, US electrical demand will increase from about 700 gigawatts (GW) in 1990 to nearly 900 GW by 2010. As part of this projection, the NES estimates that about 40 GW of current capacity will be retired by 2010, and another 340 GW will need to be refurbished for extended life. Thus, even if all the plant life extensions are carried out, approximately 240 GW of new capacity will be needed in that 20-year time span. Our nation's utilities have a growing number of options available for meeting this anticipated increase in demand. These options include the greater use of demand-side management techniques to further reduce the anticipated growth in demand; the provision of increasing amounts of electricity from domestic, environmentally attractive, renewable energy sources; and more effective use of the utility sector's substantial existing assets in generation, transmission, and distribution systems. The Office of Utility Technologies, part of DOE's Office of Conservation and

Renewable Energy, is working collaboratively with utilities and industry to address the technological and institutional constraints that impede utility adoption of renewable energy and energy efficiency technologies, and to realize the full market potential for these technologies, both here and abroad. This document presents brief descriptions of specific projects supported and carried out successfully by the Office of Utility Technologies as part of its effort to carry out this mission. These "success stories" range from significant research results to commercialization of new technologies. Each success story stands alone as a specific achievement, but when taken as a whole, the success stories form a collage that suggests a vision of the future for utilities.

26464 (DOE/EIA–0226(93/04)) **Electric power monthly, April 1993.** USDOE Energy Information Administration, Washington, DC (United States). Office of Coal, Nuclear, Electric and Alternate Fuels. 7 May 1993. 277p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93013290. Source: OSTI; NTIS; GPO; GPO Dep.

The Electric Power Monthly is prepared by the Survey Management Division; Office of Coal, Nuclear, Electric and Alternate Fuels, Energy Information Administration (EIA), Department of Energy. This publication provides monthly statistics at the US, Census division, and State levels for net generation, fossil fuel consumption and stocks, quantity and quality of fossil fuels, cost of fossil fuels, electricity sales, revenue, and average revenue per kilowatthour of electricity sold. Data on net generation, fuel consumption, fuel stocks, quantity and cost of fossil fuels are also displayed for the North American Electric Reliability Council (NERC) regions.

26465 (DOE/EIA–0226(93/05)) **Electric power monthly, May 1993.** USDOE Energy Information Administration, Washington, DC (United States). Office of Oil and Gas. 25 May 1993. 202p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93014383. Source: OSTI; NTIS; GPO; GPO Dep.

The Electric Power Monthly (EPM) is prepared by the Survey Management Division; Office of Coal, Nuclear, Electric and Alternate Fuels, Energy Information Administration (EIA), Department of Energy. This publication provides monthly statistics at the US, Census division, and State levels for net generation, fossil fuel consumption and stocks, quantity and quality of fossil fuels, cost of fossil fuels, electricity sales, revenue, and average revenue per kilowatthour of electricity sold. Data on net generation, fuel consumption, fuel stocks, quantity and cost of fossil fuels are also displayed for the North American Electric Reliability Council (NERC) regions.

26466 (LBL–33741) **Prospects for the power sector in nine developing countries.** Meyers, S.; Goldman, N.; Martin, N.; Friedmann, R. Lawrence Berkeley Lab., CA (United States). Apr 1993. 132p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. Order Number DE93016712. Source: OSTI; NTIS; INIS; GPO Dep.

Based on information drawn primarily from official planning documents issued by national governments and/or utilities, the authors examined the outlook for the power sector in the year 2000 in nine countries: China, India, Indonesia, Thailand, the Philippines, South Korea, Taiwan, Argentina and Mexico. They found that the implicit rates of average annual growth of installed electric power capacity between 1991 and 2001 range from a low of 3.3% per year in Argentina to a high of 13.2% per year in Indonesia. In absolute terms, China and India account for the vast majority of the growth. The plans call for a shift in the generating mix towards coal in six of the countries, and continued strong reliance on coal in China and India. The use of natural gas is expected to increase substantially in a number of the countries. The historic movement away from oil continues, although some countries are maintaining dual-fuel capabilities. Plans call for considerable growth of nuclear power in South Korea and China and modest increases in India and Taiwan. The feasibility of the official plans varies among the countries. Lack of public capital is leading towards greater reliance on private sector participation in power projects in many of the countries. Environmental issues are becoming a more significant constraint than in the past, particularly in the case of large-scale hydropower projects. The financial and environmental constraints are leading to a rising interest in methods of improving the efficiency of electricity supply and end use. The scale of such activities is growing in most of the study countries.

26467 (LIU-TEK-LIC–93-12) **Cost-effective incentives for local electric utilities and industries in co-operation: Modelling of technical measures.** Linkoeping Studies in Science and Technology. Andersson, Maria. Linkoeping Univ. (Sweden). Dept. of Mechanical Engineering. 1993. 112 p.p. Order Number DE93500888. Source: OSTI; NTIS.

In the Swedish electricity system there is a great potential for increasing the cost efficiency of the electricity use. However, today the economic incentives, offered for instance by existing electricity rates, are too weak to improve the use of the system. The power producer, the distributor and the customer act separately due to low awareness of the costs for electricity generation, over the year and the day. If the actors are aware of the real electricity costs, cost-effective incentives will arise to introduce measures that will reduce the energy system cost considerably. This thesis presents two energy system analyses of an existing Swedish municipality. The first analysis deals with the introduction of industrial end-use measures, with the local utility's existing electricity rates as boundary conditions. The analysis is carried out with a simulation model for electricity use in industries. The second analysis deals with the introduction of energy system measures, on the municipal supply-side and demand-side, when the local electric utility and the customers are regarded as one system. The analysis is carried out with an optimisation model, which is based on linear programming. The results show that if 17 industries introduce end-use measures, with the existing electricity rates as boundary conditions, their energy system costs will be reduced by 12 MSEK for a time period of 10 years, whereas the local electric utility will increase its energy system cost by 6 MSEK. However, if there is a cooperation between the local electric utility and the customers, their joint energy system cost will be reduced by 330 MSEK for a time period of 10 years. (33 refs., 26 figs., 28 tabs.).

26468 (NEI-SE–119) **Sweden's electric power supply 1992.** KRAFTSAM, Stockholm (Sweden); Kraftverksfoereningen, Stockholm (Sweden); Vattenfall AB, Vaellingby (Sweden). 1993. 29p. (In Swedish). Order Number DE93500838. Source: OSTI; NTIS.

With 2p English summary.

In 1992 the input of energy to the Swedish energy balance was 510 TWh according to WEC-definitions. The input of fuels amounted to 257 TWh, from which only 9 TWh were used for electricity production. The end use of energy reached a total of 367 TWh, of which 133 TWh were used in industry and 151 TWh in housing, services and district heating. 83 TWh were used in the transport system. The total production of electricity was 141 TWh. The two main power sources were hydro power and nuclear power, with 73 and 61 TWh respectively in 1992. The rest, about 7 TWh, were chiefly CHP-production. Only 0.7 TWh was oil fired condensing power. In the end of 1992 the total net capacity installed in the Swedish power stations was about 34000 MW, out of which 48 per cent was hydro power, 29 per cent nuclear power and 23 per cent power based on fossil fuels and biomass. As the Swedish power production is dominated by hydro power and nuclear power, the electricity production shares of the national emissions of CO2, SO2 and NOx are very low by international standards. The emissions of CO2 from power production are about 1.5 million tons to be compared with about 60 million tons for Sweden as a whole. For SO2 and NOx the same development applies as for CO2 but even more pronounced as the national emission standards for SO2 and NOx have grown more and more rigorous during this period. (24 figs., 11 tabs.).

26469 (NUTEK-R–92-44) **Norway - effects of deregulation.** Swedish National Board for Industrial and Technical Development (NUTEK), Stockholm (Sweden). Oct 1992. 62 p.p. (In Swedish). Order Number DE93500665. Source: OSTI; NTIS; INIS.

The electricity market of Norway was deregulated in 1991, changing a regional monopoly market to a national competitive market with third party access to transmission lines. In the report, the effects of the deregulations on utilities, geografical differences on prices and prices in general one year after the deregulation are analyzed. (21 figs., 35 tabs.).

26470 (PNL–8588) **Western Area Power Administration customer database.** Sandahl, L.J.; Lee, A.D.; Wright, G.A.; Durfee, D.L. Pacific Northwest Lab., Richland, WA (United States). May 1993. 25p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93014849. Source: OSTI; NTIS; GPO Dep.

This report describes a comprehensive customer database compiled by the Pacific Northwest Laboratory (PNL) to assist with analyses conducted as part of the Western Area Power Administration Energy Planning and Management Program Environmental Impact Statement (EIS). The database was used by PNL as a tool to help select a sample of Western customers for potential participation in the Organizational Impacts Analysis case studies, and was used as part of the Utility Impact Analysis to identify sources and costs of auxiliary power. Secondary information sources were used predominantly to compile one year of system related information on the Western customers (over 600) included in the database. This information was useful for its intended purposes; however, year-to-year information may not be consistent across utilities and not all information was available for each utility.

2980 Consumption and Utilization

Refer also to citation(s) 26408, 26450, 26460, 26504

26471 (DOE/EIA–0214(91)) **State Energy Data Report, 1991: Consumption estimates.** USDOE Energy Information Administration, Washington, DC (United States). Office of Energy Markets and End Use. May 1993. 516p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93013921. Source: OSTI; NTIS; INIS; GPO; GPO Dep.

The State Energy Data Report (SEDR) provides annual time series estimates of State-level energy consumption by major economic sector. The estimates are developed in the State Energy Data System (SEDS), which is maintained and operated by the Energy Information Administration (EIA). The goal in maintaining SEDS is to create historical time series of energy consumption by State that are defined as consistently as possible over time and across sectors. SEDS exists for two principal reasons: (1) to provide State energy consumption estimates to the Government, policy makers, and the public; and (2) to provide the historical series necessary for EIA's energy models.

26472 (LBL–32362) **Energy use in Denmark: An international perspective.** Schipper, L.; Howarth, R.; Andersson, B.; Price, L. Lawrence Berkeley Lab., CA (United States). Aug 1992. 176p. DOE Contract AC03-76SF00098. Order Number DE93015219. Source: OSTI; NTIS; GPO Dep.

This report analyzes the evolution use in Denmark since the early 1970s in order to shed light on the future path of energy use in Denmark, with particular emphasis on the role of energy efficiency. The authors found that improvements in end-use energy efficiency reduced primary energy requirements in Denmark by 22% between 1972 and 1988. Focusing on developments in six individual sectors of the Danish economy (residential, manufacturing, other industry, service, travel, and freight), they found that the residential, manufacturing, and service sectors have led the improvements in efficiency. Travel showed few significant improvements and the efficiency of freight transportation worsened. The international comparisons showed that the structure of energy use in Denmark is less energy-intensive than that of most high-income OECD countries, with the exception of Japan. Overall, they concluded that most of the energy savings achieved in Denmark were brought about through improvements in technology. They also found that an important stimulus for improved efficiency was higher energy prices, led in no small part by significant taxes imposed on small consumers of heating oil, electricity, and motor fuels. Energy-efficiency programs accelerated energy savings in homes and commercial buildings. The rate of improvement of energy efficiency in Denmark has slowed down significantly since 1984, consistent with trends observed in other major countries. While many of the energy-efficiency goals stated or implied in Denmark's Energi 2000 are achievable over a very long period, present trends do not point towards achievement of these goals by 2010 or even 2020. Strong measures will have to be developed by both public and private authorities if energy efficiency is to make a key contributions to reducing environmental problems associated with energy use in Denmark.

26473 (LBL–33166) **Trends in electricity demand and supply in the developing countries, 1980–1990.** Meyers, S.; Campbell, C. Lawrence Berkeley Lab., CA (United States). Nov 1992. 50p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. Order Number DE93015370. Source: OSTI; NTIS; GPO Dep.

This report provides an overview of trends concerning electricity demand and supply in the developing countries in the 1980–1990 period, with special focus on 13 major countries for which we have assembled consistent data series. We describe the linkage between electricity demand and economic growth, the changing sectoral composition of electricity consumption, and changes in the mix of energy sources for electricity generation. We also cover trends in the efficiency of utility electricity supply with respect to power plant efficiency and own-use and delivery losses, and consider the trends in carbon dioxide emissions from electricity supply.

2990 Unconventional Sources and Power Generation

Refer also to citation(s) 25959, 25963, 26412, 26451, 26471

26474 (ENEA-RTI-STUDI-ENE–92-03) **MePER (Methodology in support of Regional Energy Programming).** Giuffrida, L.G. ENEA, Rome (Italy). Direzione Studi. Dec 1992. 142p. (In Italian). (RTI/STUDI-ENE–92-3). Order Number DE93799203. Source: OSTI; NTIS (US Sales Only).

In 1987, the ENEA (the Italian Agency for New Technology, Energy and the Environment) Studies Division developed and issued an instruction manual for the carrying out of Italian regional energy balance assessments. Recently revised National Energy Plan strategies which now incorporate the new European Communities environmental protection guidelines have necessitated the simplification, up-dating and broadening of the energy balance instruction manual called MePER (Methodology in support of Regional Energy Programming). The new MePER manual includes instructions for the implementation of a new information system for the compilation of modules quantifying and assessing regional energy supply and demand situations, and regional potentials for the development and use of available renewable energy sources such as mini-hydraulic, photovoltaic and eolian.

26475 (ETDE-IT–93-153) **MePER methodology: Methods and instruments for regional energy planning.** Giuffrida, L.G.; Catoni, P.G. ENEA, Rome (Italy). Direzione Studi. 1992. 8p. (CONF-921214–1: 7. international energy conference: world energy demand - is growth inevitable?, London (United Kingdom), 7-8 Dec 1992). Order Number DE93799181. Source: OSTI; NTIS (US Sales Only).

In the last ten years, energy planning has become one of the most important strategic elements in local-level government programmes. In line with this new emphasis, legislation passed in Italy in the last few years has assigned to Regional Authorities wider and wider powers of intervention in the energy sector and has specifically called on the Regions to draw up regional energy programmes concerning energy saving and the development of renewable energy sources. To aid the regions in their efforts to comply with this new legislation, ENEA (National Agency for New Technology, Energy and the Environment) put at their disposal for regional energy planning standard methodology, developed some years previously, called MePER (MEthodology for Regional Energy Planning). The principle function of MePER is to provide Regional Planning Authorities with sufficient data to enable them to draw up a set of realistic energy-related goals and objectives. In particular, MePER provides the means to: obtain base information on regional energy systems; obtain detailed information on regional energy production methods and uses; and identify energy saving and conservation measures; assess the economic and environmental impacts of these measures on the energy sector.

26476 (LA-UR–93-1991) **Hot dry rock: What does it take to make it happen.** Duchane, D.V. Los Alamos National Lab., NM

(United States). [1993]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930484–2: Geothermal program review, Berkeley, CA (United States), 27-29 Apr 1993). Order Number DE93014343. Source: OSTI; NTIS; INIS; GPO Dep.

The ubiquitous heat in hot dry rock (HDR) is an abundant, widely distributed form of geothermal energy. Until recently, development of this energy source has been largely focused on understanding the scientific and engineering principles involved in forming and operating HDR reservoirs. During the past year, however, a pilot facility at Fenton Hill, NM has been run under steady-state conditions simulating the operation of a commercial HDR energy plant. Issues important to commercialization such as sustainability of thermal production, water loss, operating costs, and others have been addressed to the extent possible. The results, while not always definitive, have been encouraging. The stage is now set for the formation of an initiative led by private industry to take HDR technology from its current state of scientific and engineering demonstration to the production and marketing of energy in commercial quantities. Because of the technology risks involved, this can probably only be accomplished through a cost-shared industry/government effort. The potential rewards are great, since HDR represents the best, and perhaps the only, opportunity for geothermal energy to take its rightful place as a major energy source for the 21st century.

26477 (NEI-DK–1200) **Biomass for energy and industry.** Rockson, J.K. Nordvestjysk Folkecenter for Vedvarende Energi, Hurup (Denmark). Oct 1992. 97p. Order Number DE93500179. Source: OSTI; NTIS.

Economic and environmental seasons require the substitution of fossil resources with renewable ones. This substitution must be such that it provides both energy and environmental advantages. It must also be a sustainable innovation, i.e. it must not prejudice the availability of other resources in the biosphere. At present it seems that the best prospects for the substitution of fossil resources and for the maintenance of the delicate biosphere equilibria seems to be the capture of solar energy by photosynthesis, biomass and wind energy i.e. energy derived from the sun (aeolic, hydro, direct solar radiation, biomass). As regards suitability for biogas production, organic substrates could be divided into four main categories, i.e. animal wastes, agricultural residues, industrial wastes and wood fuel. Temperature plays an important part in biogas production due to the fermentation process, which leads to the gas production. In many respects H_2S is not an attractive energy medium. H_2S is dangerous to every metal or material since it reduces the lifespan of every material, metal or element that comes in contact with. The removal of H_2S with the addition of $FeCl_2$ is therefore a great achievement especially for biogas production and for biogas plants. The $FeCl_2$ combines with the H_2S which runs out with the gas. (au).

30 DIRECT ENERGY CONVERSION

3001 MHD Generators

26478 (DOE/PC/90309–10) **Anion-exchange resin-based desulfurization process: Quarterly technical progress report, January 1, 1993–March 31, 1993.** Sheth, A.C.; Dharmapurikar, R. Tennessee Univ., Tullahoma, TN (United States). Space Inst. [1993]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-90PC90309. Order Number DE93014520. Source: OSTI; NTIS; GPO Dep.

Under DOE Grant No. FG22-90PC90309, the University of Tennessee Space Institute (UTSI) is contracted to further develop its anion-exchange, resin-based desulfurization concept to desulfurize alkali metal sulfates. From environmental as well as economic viewpoints, it is necessary to remove soluble sulfates from the wastes created by flue gas desulfurization systems. In order to do this economically, a low-cost desulfurization process for spent sorbents is necessary. UTSI's anion-exchange resin-based desulfurization concept is believed to satisfy these requirements. UTSI has completed the batch mode experiments to locate the position of the CO_3^{2} and SO_4^{2} ions in the affinity chart. Also, the reviews of the ASPEN Code's capabilities and EPRI-TAG document's methodology are in progress for developing the Best Process Schematic and related economics. The fixed-bed experiments are also in progress to evaluate the cycle efficiency of the candidate resins. So far we have completed ten consecutive cycles of exhaustion/carbonation and regeneration for IRA-35 resin. Because of the past problems (now resolved) with the fixed-bed system, the addition of batch mode screening experiments, Christmas holidays and spring break, and the moving of UTSI's Chemistry Laboratory to a new location, the program is about 6–8 weeks behind schedule, but well within the budget.

3003 Thermoelectric Generators

Refer also to citation(s) 25921, 26208

3005 Fuel Cells

Refer also to citation(s) 25485, 25499, 26098

26479 (DOE/MC/27168–93/C0188) **Carbonate fuel cell endurance: Hardware corrosion and electrolyte management status.** Yuh, C.; Johnsen, R.; Farooque, M.; Maru, H. Energy Research Corp., Danbury, CT (United States). [1993]. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC21-90MC27168. (CONF-930571–13: 183. Electrochemical Society meeting, Honolulu, HI (United States), 16-21 May 1993). Order Number DE93013800. Source: OSTI; NTIS; GPO Dep.

Endurance tests of carbonate fuel cell stacks (up to 10,000 hours) have shown that hardware corrosion and electrolyte losses can be reasonably controlled by proper material selection and cell design. Corrosion of stainless steel current collector hardware, nickel clad bipolar plate and aluminized wet seal show rates within acceptable limits. Electrolyte loss rate to current collector surface has been minimized by reducing exposed current collector surface area. Electrolyte evaporation loss appears tolerable. Electrolyte redistribution has been restrained by proper design of manifold seals.

26480 (DOE/MC/27168–93/C0189) **Performance effects of coal-derived contaminants on the carbonate fuel cell.** Pigeaud, A. (Energy Research Corp., Danbury, CT (United States)); Wilemski, G. Energy Research Corp., Danbury, CT (United States). [1993]. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC21-90MC27168. (CONF-9305101–1: 3. international symposium on carbonate fuel cell technology, Honolulu, HI (United States), 16-21 May 1993). Order Number DE93013801. Source: OSTI; NTIS; GPO Dep.

Coal-derived contaminant studies have been pursued at ERC since the early 1980's when the pace of carbonate fuel cell development began to markedly increase. Initial work was concerned with performance effects on laboratory and bench-scale carbonate fuel cells primarily due to sulfur compounds. Results have now also been obtained with respect to nine additional coal-gas contaminants, including volatile trace metal species. Thermochemical calculations, out-of-cell experiments, and cell performance as well as endurance testshave recently been conducted which have involved the following species: NH_3, H_2S [COS], HCl, $AsH_3[As_2(v)]$, Zn(v), Pb(v), Cd(v), H_2 Se, Hg(v), Sn(v). Employing thermochemically calculated results, thermogravimetric (TGA) and pre-, and post-test analytical data as well as fuel cell performance observations, it has been shown that there are four main mechanisms of contaminant interaction with the carbonate fuel cell. These have been formulated into performance models for six significant contaminant species, thus providing long-term endurance estimations.

26481 (DOE/MC/28065–3371) **Molten carbonate fuel cell product development test environmental assessment/protection plan.** M-C Power Corp., Burr Ridge, IL (United States). Nov 1992. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC21-92MC28065. Order Number DE93000288. Source: OSTI; NTIS; GPO Dep.

Objective of proposed action is to conduct a 250-kW product development test of M-C Power Corporation's molten carbonate fuel cell concept, at the Kaiser Permanente San Diego Medical Center.

Review of environmental impacts of this test indicate the following: no impact on solid waste disposal, water quality, noise levels, floodplains, wetlands, ecology, historic areas, or socioeconomic resources. Impact on air quality are expected to be positive.

26482 (DOE/METC/C–93/7083) **Status of SOFC development in USA.** Hooie, D.T. USDOE Morgantown Energy Technology Center, WV (United States). [1993]. 5p. Sponsored by USDOE, Washington, DC (United States). (CONF-9305101–3: 3. international symposium on carbonate fuel cell technology, Honolulu, HI (United States), 16-21 May 1993). Order Number DE93015568. Source: OSTI; NTIS; GPO Dep.

Solid oxide fuel cells represent a highly efficient power generation/cogeneration source in the United States and worldwide. Currently, the US is a leader in this technology in the tubular, monolithic and planar solid oxide fuel cell areas. In addition, research is being conducted in intermediate temperature solid oxide fuel cells. An overview of the status of these technologies, research, and critical issues is presented.

26483 (LA-UR–93-1305) **Primary and secondary electrical space power based on advanced PEM systems.** Vanderborgh, N.E. (Los Alamos National Lab., NM (United States)); Hedstrom, J.C.; Stroh, K.R.; Huff, J.R. Los Alamos National Lab., NM (United States). [1993]. 9p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9304142–1: 4. space electrochemical research and technology conference, Cleveland, OH (United States), 14-15 Apr 1993). Order Number DE93012643. Source: OSTI; NTIS; GPO Dep.

For new space ventures, power continues to be a pacing function for mission planning and experiment endurance. Although electrochemical power is a well demonstrated space power technology, current hardware limitations impact future mission viability. In order to document and augment electrochemical technology, a series of experiments for the National Aeronautics and Space Administration Lewis Research Center (NASA LeRC) are underway at the Los Alamos National Laboratory that define operational parameters on contemporary proton exchange membrane (PEM) hardware operating with hydrogen and oxygen reactants. Because of the high efficiency possible for water electrolysis, this hardware is also thought part of a secondary battery design built around stored reactants – the so-called regenerative fuel cell. An overview of stack testing at Los Alamos, and of analyses related to regenerative fuel cell systems are provided in this paper. Finally, this paper describes work looking at innovative concepts that remove complexity from stack hardware with the specific intent of higher system reliability. This new concept offers the potential for unprecedented electrochemical power system energy densities.

26484 (NEI-DK–1194) **Abstracts of Nordisk Ministerraads workshop on high temperature electrode materials.** Poulsen, F.W.; Ahlgren, E.; Holt, A. (eds.). Risoe National Lab., Roskilde (Denmark). Materials Dept. Dec 1992. 194 p.p. (CONF-9210373–Absts.: Workshop on high temperature electrode materials, Roskilde (Denmark), 26-27 Oct 1992). Order Number DE93500259. Source: OSTI; NTIS.

Abstracts of papers presented at The Nordic Council of Ministers workshop held in Roskilde, Denmark, in October 1992 deal with ceramic electrodes used in solid oxide (SOFC) and molten carbonate fuel cells (MCFC). Participants originated from Norway, Denmark, the Netherlands and the United Kingdom. The eleven lectures ranged under the headings of structure and thermodynamics, transport properties, kinetics and general SOFC technology. The state of the art of SOFCs was also generally discussed, and an overview of materials research related to MCFC was given. (AB).

26485 (NEI-DK–1194, pp. 6-26) **Exact solutions to Kroeger-Vink diagrams for perovskites.** Poulsen, F.W. (Materials Department, Risoe National Laboratory, Roskilde (Denmark)). Risoe National Lab., Roskilde (Denmark). Materials Dept. Dec 1992. (CONF-9210373–Absts.: Workshop on high temperature electrode materials, Roskilde (Denmark), 26-27 Oct 1992). In *Abstracts of Nordisk Ministerraads workshop on high temperature electrode materials.* 194 p.p. Order Number DE93500259. Source: OSTI; NTIS.

Simulations of the defect chemistry are presented for $LaMnO_{3+\delta}$, $La_{1-x}Sr_xMn_yO_{3+\delta}$ and $Nd_xCr_{1-y}Ti_yO_{3+\delta}$. Contrary to previous defect chemistry calculations (Kroeger-Vink diagram type) a complete numerical solution to the problem has been found, avoiding the problem of dividing the diagram into sub-problems and using approximated equations for the various defect regimes. The transition regions, which may extend over several decades of oxygen partial pressure, become subjectable to analysis and prediction. Three equilibrium constants are required in the description of perovskites: a redox type-, a Schottky type-, and an ionisation type constant. The set of 8 or 9 equations controlling the host ion- and defect concentrations are solved by a trial and error method: the oxygen ion vacancy concentration is stepped through its parametric space (approx. 10^{-10} to 1) and an intelligent criterium for eliminating the non-physical solutions is used. A warning against use of commercial PC-"equation solving packages" is given. When these work, they are slower than the present procedure. The present algorithm is capable of synthesising K.-V.-diagrams over at least 50 decades of oxygen pressures. Perovskites with pure electrolyte properties, as well as pure p-type material can be simulated. The oxygen content vs pO_2 relationship is correctly predicted as well as the slopes in the K.-V.-diagrams. The idea of also using a "differentiated K.-V.-diagram" i.e. a $d\log(c)/d\log pO_2$ vs $\log pO_2$ diagram is advocated. The slopes may converge towards "peculiar" numbers for certain combinations of equilibrium constants, without this meaning that a completely new type of defect must be invoked. (AB).

26486 (NEI-DK–1194, pp. 27-32) **Stoichiometry and structure of (La,Sr)MnO_3.** Skou, E. (Department of Chemistry, Odense University, Odense (Denmark)). Risoe National Lab., Roskilde (Denmark). Materials Dept. Dec 1992. (CONF-9210373–Absts.: Workshop on high temperature electrode materials, Roskilde (Denmark), 26-27 Oct 1992). In *Abstracts of Nordisk Ministerraads workshop on high temperature electrode materials.* 194 p.p. Order Number DE93500259. Source: OSTI; NTIS.

In the literature the dependency of stoichiometry of LSM (belonging to the family of perovskites with the general formula ABO_3) on the partial pressure of oxygen has usually been determined by thermogravimetry. In these investigations nominal stoichiometry (i.e. $O_{3.00}$) is usually assumed as an oxygen partial pressure of 10^{-9} to 10^{-6} atm where the composition is independent of the partial pressure, but no direct proof of this has been given. It was therefore decided to determine the absolute composition of selected samples equilibrated at different oxygen partial pressures. Physical methods (atomic absorption and X-ray fluorescence) was judged to be too inaccurate so a chemical analysis was attempted. On a selected sample the stoichiometry was also determined by a Rietveld refinement on X-ray and neutron powder diffraction data. In addition phase stability and unit cell volumes have been determined by X-ray powder diffraction. (AB).

26487 (NEI-DK–1194, pp. 33-58) **Oxide ion conduction and mixed conduction in $LaTa_3O_9$, $Ba_6Ta_2O_{11}$ and $Ca_{12}Al_{14}O_{33}$.** West, A.R. (University of Aberdeen, Department of Chemistry, Aberdeen (United Kingdom)). Risoe National Lab., Roskilde (Denmark). Materials Dept. Dec 1992. (CONF-9210373–Absts.: Workshop on high temperature electrode materials, Roskilde (Denmark), 26-27 Oct 1992). In *Abstracts of Nordisk Ministerraads workshop on high temperature electrode materials.* 194 p.p. Order Number DE93500259. Source: OSTI; NTIS.

Short communication. SOLID ELECTROLYTES/ionic conductivity; LANTHANUM OXIDES; TANTALUM OXIDES; BARIUM OXIDES; CALCIUM OXIDES; ALUMINIUM OXIDES; PEROVSKITE; TEMPERATURE DEPENDENCE; CERAMICS; FUEL CELLS; ELECTRIC IMPEDANCE; DOPED MATERIALS; EXPERIMENTAL DATA; QUALITATIVE CHEMICAL ANALYSIS; MAGNETIC MATERIALS

26488 (NEI-DK–1194, pp. 59-90) **Surface oxygen exchange kinetids of solid oxide ion conductors.** Boukamp, B.A. (University of Twente, University for technical and Social Sciences (Netherlands)); Vinke, I.C.; Loescher, B.; Vries, K.J. de; Burggraaf, A.J. Risoe National Lab., Roskilde (Denmark). Materials Dept. Dec 1992. (CONF-9210373–Absts.: Workshop on high temperature electrode materials, Roskilde (Denmark), 26-27 Oct 1992). In *Abstracts of Nordisk Ministerraads workshop on high temperature*

electrode materials. 194 p.p. Order Number DE93500259. Source: OSTI; NTIS.

Photocopies of overheads illustrate a detailed discussion of surface oxygen exchange kinetics of solid oxide ion conductors in relation to solid electrolyte fuel cells. (AB).

26489 (NEI-DK–1194, pp. 91-104) **Impedance spectroscopy applied on sofc-related problems.** Norby, T. (Center for Materials Research, University of Oslo (Norway)); Halvorsen, L.; Velle, O.J.; Leth-Olsen, H. Risoe National Lab., Roskilde (Denmark). Materials Dept. Dec 1992. (CONF-9210373–Absts,: Workshop on high temperature electrode materials, Roskilde (Denmark), 26-27 Oct 1992). In *Abstracts of Nordisk Ministerraads workshop on high temperature electrode materials.* 194 p.p. Order Number DE93500259. Source: OSTI; NTIS.

Measurements of the ionic conductivity of $La_{0.7}Ca_{0.3}Cr_{0.95}Ca_{0.05}O_3$ has been attempted using a set-up with stabilized zirconia blocking for electronic charge transport. The calculated activation energy for ionic conductivity was 0.89 eV, which was in reasonable agreement with literature results. However, oxygen dependency measurements gave results diverging from what was expected for oxygen vacancy migration, and instead followed the oxygen dependency of p-type conductivity. It is therefore believed that the method failed in our case, as the measured conductivity represented a fraction of the p-type conductivity. There was nevertheless reasonable correspondence between our results and results in the literature. (au).

26490 (NEI-DK–1194, pp. 105-121) **On the measurement and interpretation of transport properties of mixed conductors.** Nisancioglu, K. (Norges Tekniske Hoegskole, Institutt for Teknisk Elektrokjemi, Trondheim (Norway)). Risoe National Lab., Roskilde (Denmark). Materials Dept. Dec 1992. (CONF-9210373–Absts.: Workshop on high temperature electrode materials, Roskilde (Denmark), 26-27 Oct 1992). In *Abstracts of Nordisk Ministerraads workshop on high temperature electrode materials.* 194 p.p. Order Number DE93500259. Source: OSTI; NTIS.

It is generally agreed that the ionic transport properties of mixed conductors can directly be measured by tracer techniques, which normally require one specimen per measurement. Since electrochemical and non-destructive gravimetric methods are frequently applied because these methods in principle allow infinite number of measurements; however data interpretation is less straightforward. This paper, therefore, reviews the theoretical basis for the determination of transport properties by these methods, with emphasis on the type of assumptions involved and the physical significance of the measured quantities. (au).

26491 (NEI-DK–1194, pp. 139-148) **Methane oxidation on oxide catalysts.** Middleton, P.H. (Department of Materials, Imperial College of Science Technology and Medicine, London (United Kingdom)). Risoe National Lab., Roskilde (Denmark). Materials Dept. Dec 1992. (CONF-9210373–Absts.: Workshop on high temperature electrode materials, Roskilde (Denmark), 26-27 Oct 1992). In *Abstracts of Nordisk Ministerraads workshop on high temperature electrode materials.* 194 p.p. Order Number DE93500259. Source: OSTI; NTIS.

Short communication. SOLID ELECTROLYTE FUEL CELLS/methane; SOLID ELECTROLYTE FUEL CELLS/catalysts; OXIDATION; OXIDES; METHANE; CATALYSTS; SEMICONDUCTOR MATERIALS; ELECTRONS; MATRIX MATERIALS; CARBON; COUPLING; EXPERIMENTAL DATA

26492 (NEI-DK–1194, pp. 149-178) **Electrode kinetics of SOFC anodes and cathodes.** Mogensen, M. (Materials Department, Risoe National Laboratory, Roskilde (Denmark)). Risoe National Lab., Roskilde (Denmark). Materials Dept. Dec 1992. (CONF-9210373–Absts.: Workshop on high temperature electrode materials, Roskilde (Denmark), 26-27 Oct 1992). In *Abstracts of Nordisk Ministerraads workshop on high temperature electrode materials.* 194 p.p. Order Number DE93500259. Source: OSTI; NTIS.

Short communication. SOLID ELECTROLYTE FUEL CELLS/anodes; SOLID ELECTROLYTE FUEL CELLS/cathodes; ELECTRODES; ANODES; CATHODES; ELECTROCATALYSTS; ELECTROLYTES; ELECTRONS; HYDROGEN; WATER; NICKEL; ELECTRIC IMPEDANCE; REACTION KINETICS; CURRENT DENSITY

26493 (NEI-DK–1194, pp. 179-190) **The Statoil SOFC program.** Oedegaard, R. (Statoil Research Centre, Trondheim (Norway)). Risoe National Lab., Roskilde (Denmark). Materials Dept. Dec 1992. (CONF-9210373–Absts.: Workshop on high temperature electrode materials, Roskilde (Denmark), 26-27 Oct 1992). In *Abstracts of Nordisk Ministerraads workshop on high temperature electrode materials.* 194 p.p. Order Number DE93500259. Source: OSTI; NTIS.

Short communication. SOLID ELECTROLYTE FUEL CELLS/natural gas; RESEARCH PROGRAMS; PETROLEUM INDUSTRY; FEASIBILITY STUDIES; ELECTRODES; PRODUCTION; ZIRCONIUM OXIDES; LANTHANUM OXIDES; CALCIUM; YTTRIUM; METHANE; HYDROGEN; LIFETIME; DESIGN

26494 (NEI-DK–1194, pp. 191-192) **Swedish research on MCFC.** Bergman, B. (Department of Physical Metallurgy and Ceramics Technology, Royal Institute of Technology, Stockholm (Sweden)). Risoe National Lab., Roskilde (Denmark). Materials Dept. Dec 1992. (CONF-9210373–Absts.: Workshop on high temperature electrode materials, Roskilde (Denmark), 26-27 Oct 1992). In *Abstracts of Nordisk Ministerraads workshop on high temperature electrode materials.* 194 p.p. Order Number DE93500259. Source: OSTI; NTIS.

Short communication. MOLTEN CARBONATE FUEL CELLS/cathodes; CATHODES; SWEDEN; RESEARCH PROGRAMS; EXPERIMENTAL DATA; PERFORMANCE TESTING; LITHIUM OXIDES; COBALT OXIDES; NITROGEN OXIDES

26495 (NEI-DK–1194, pp. 122-138) **On the SOFC cathode reaction.** Jacobsen, T. (Fysisk-Kemisk Institut, The Technical University of Denmark, Lyngby (Denmark)); Lade, K. Risoe National Lab., Roskilde (Denmark). Materials Dept. Dec 1992. (CONF-9210373–Absts.: Workshop on high temperature electrode materials, Roskilde (Denmark), 26-27 Oct 1992). In *Abstracts of Nordisk Ministerraads workshop on high temperature electrode materials.* 194 p.p. Order Number DE93500259. Source: OSTI; NTIS.

The detailed mechanism has not been established for the overall cathode reaction $O_2+4e \rightleftharpoons 2O^{--}$. We assume that the reaction is distributed on to the surface of the porous electrode. The driving force for the electrochemical reaction is the perturbation of the oxide concentration at the reaction site. For electrode materials with high electronic conductivity, the distribution of the reaction density is determined by the concentration profile of the O^{--} ions produced. This is determined by the transport from the reaction site to the surface of the zirconia electrolyte. This diffusion can be surface and/or, in the case of an ion conducting electrode material, bulk diffusion. A simple mathematical treatment identifies two limiting cases: Thin electrodes, where the surface reaction is the rate limiting step, have a uniform distribution of the reaction density on the surface and they behave as conventional planar electrodes. Thick electrodes, where the diffusion of O^{--} is limiting and the reaction density decreases with the distance from the electrolyte surface. These, behave as porous electrodes and measurable quantities like reaction orders differ from those expected from planar electrode theory. An electrochemical impedance technique applied to a dense LSM pellet inside an oxygen pumping cell is described. From these experiments, information on the surface reaction as well as the O^{--} bulk diffusion coefficient can be obtained. (AB).

26496 (PNL-SA–21621) **Chemical interactions between interconnect and electrode materials during sintering in solid oxide fuel cells.** Armstrong, T.R.; Chick, L.A.; Bates, J.L. Pacific Northwest Lab., Richland, WA (United States). May 1993. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-9305100–2: 3. international symposium on solid oxide fuel cells, Honolulu, HI (United States), 16-21 May 1993). Order Number DE93015696. Source: OSTI; NTIS; GPO Dep.

Chemical interactions and interdiffusion between the interconnect, $(LaCa)CrO_3$ and $(YCa)CrO_3$ and the anode, $Ni{\cdot}ZrO_2$, and cathode, $(LaSr)MnO_3$ and $(YCa)MnO_3$, were evaluated from 1300 to 1500C. Reaction of $(LaCa)CrO_3$ and $Ni{\cdot}ZrO_2$ cermet resulted in the formation of $NiCr_2O_4$ spinel, while reaction of $(YCa)CrO_3$ and

Ni·ZrO_2 resulted in the formation of both $NiCr_2O_4$ and $CaZrO_3$, at all temperatures. Interactions between the chromites and manganites resulted in the formation of a solid solution. Dense reaction layers were observed near the interface of Ni·ZrO_2/(LaCa)CrO_3 and Ni·ZrO_2/(YCa)CrO_3 samples. These dense regions were enriched in calcium and chromium, resulting from liquid migration from the chromite to the anode. Nearly ideal interfaces were observed between (LaSr)MnO_3 and (LaCa)CrO_3. Interactions between (YCa)CrO_3 and (YCa)MnO_3 resulted in the formation of a $CaCrO_4$ rich layer along the interface.

32 ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

26497 (ORNL/CON–353) **Evaluation of the utility and energy monitoring and control system installed at the US Army, Europe, 409th Base Support Battalion, Military Community at Grafenwoehr, Germany.** Broders, M.A.; Ruppel, F.R. Oak Ridge National Lab., TN (United States). May 1993. 49p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93015633. Source: OSTI; NTIS; GPO Dep.

Under the provisions of Interagency Agreement DOE 1938-B090-A1 between the US Department of Energy (DOE) and the US Army Europe (USAREUR), Martin Marietta Energy Systems, Inc., is providing technical assistance to USAREUR in the areas of computer science, information engineering, energy studies, and engineering and systems development. One of the initial projects authorized under this interagency agreement is the evaluation of utility and energy monitoring and control systems (UEMCSs) installed at selected US Army installations in Europe. This report is an evaluation of the overall energy-conservation effectiveness and use of the UEMCS at the 409th Base Support Battalion located in Grafenwoehr, Germany. The 409th Base Support Battalion is a large USAREUR military training facility that comprises a large training area, leased housing, the main post area, and the camp areas that include Camps Aachen, Algier, Normandy, Cheb, and Kasserine. All of these facilities are consumers of electrical and thermal energy. However, only buildings and facilities in the main post area and Camps Aachen, Algier, and Normandy are under the control of the UEMCS. The focus of this evaluation report is on these specific areas. Recommendations to further increase energy and cost savings and to improve operation of the UEMCS are proposed.

3201 Buildings

Refer also to citation(s) 26452, 26532, 27352

26498 (DOE/BP–1574-Ed.2) **Building commissioning guidelines: Second edition.** Portland Energy Conservation, Inc., OR (United States). Nov 1992. 141p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93012213. Source: OSTI; NTIS; GPO Dep.

Commissioning has been a neglected element in the design, construction, and operation of buildings. Commissioning is a process for achieving, verifying, and documenting that the performance of a building and its various systems meets design intent and the owner's operational needs. Ideally, the commissioning process extends through all phases of a project, from conception to occupancy and operation. This document is written specifically to be used by utility program managers and staff. It should also be read by the utility technical staff and utility contractors responsible for delivering commissioning services, in order for them to better understand the overall commissioning process. The appendices are primarily oriented to the utility technical staff and utility contractors responsible for actually implementing commissioning. The objective of the appendices is to provide samples of forms and formats that will help streamline the implementation process.

26499 (DOE/CH/10093–187) **Program overview – Envelope systems research.** National Renewable Energy Lab., Golden, CO (United States). Apr 1993. 2p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-83CH10093. Order Number DE93013277. Source: OSTI; NTIS; GPO Dep.

The Envelope Systems Research of the Office of Building Technologies of US DOE is reviewed briefly. Current research on the building envelope and the work of the Building Envelope Research Center located at ORNL are included.

26500 (DOE/ER/45461–12) **Prediction of pitting damage functions for condensing heat exchangers.** Macdonald, D.D.; Liu, Chun; Urquidi-Macdonald, M. Pennsylvania State Univ., University Park, PA (United States). [1993]. 17p. Sponsored by USDOE, Washington, DC (United States); Gas Research Inst., Chicago, IL (United States). DOE Contract FG02-91ER45461. 5090-260-1969. (CONF-930998–3: Fall committee week of the National Association of Corrosion Engineers, Houston, TX (United States), 26 Sep - 1 oct 1993). Order Number DE93012923. Source: OSTI; NTIS; INIS; GPO Dep.

Pitting corrosion is a form of extremely localized attack resulting in rapid penetration into a metal substrate, and is one of the most destructive and insidious forms of corrosion that occurs in industrial systems. Traditionally, the damage function, i.e., the number of pits versus the pit depth, is measured experimentally, and the development of damage is described using empirical models. In general, the empirical models are successful because the distribution functions employed display great mathematical flexibility, but they require a significant database to achieve reliability. In fact, they are only really successful when the answer is known in advance. In this study, we developed a deterministic method for predicting localized corrosion damage functions for condensing heat exchangers. The method incorporates calculations for the composition of the condensed environment and the electrochemical corrosion potential of the alloy, and includes mechanistic treatments of the nucleation and the growth of pits. The role of the important environmental parameters are identified, such as the chloride concentration and the partial pressure of oxygen. Good agreement is observed between the predicted damage functions and the experimental data.

26501 (DOE/FTR–93012815) **[A meeting in Finland on innovative low-energy concepts for the year 2025]: Foreign trip report, August 30–September 6, 1992.** Rivera, J.D. D and R International Ltd., Silver Spring, MD (United States); Pacific Northwest Lab., Richland, WA (United States). 28 Sep 1992. 39p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93012815. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The purpose of the Future Buildings Forum - "2025" (Forum) is to identify and encourage research, based on long-term issues, to ensure that buildings will contribute to a sustainable society by the year 2025, and beyond. Two to three workshops are held each year on areas germane to buildings of the future.

26502 (EPA–600/R-92-203) **Literature review: Heat transfer through two-phase insulation systems consisting of powders in a continuous gas phase.** Yarbrough, D.W. Oak Ridge National Lab., TN (United States). Dec 1992. 34p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. (ORNL/M–2426). Order Number DE93014387. Source: OSTI; NTIS; GPO Dep.

This review of the literature on heat flow through powders was motivated by the use of fine powder systems to produce high thermal resistivities (thermal resistance per unit thickness). The term "superinsulations" has been used to describe this type of material, which has thermal resistivities in excess of 20 $ft^2 \cdot h \cdot F/Btu$ (3.52 $K \cdot m^2/W$) per inch (2.54 cm) of insulation thickness. The present report is concerned with superinsulations obtained using evacuated powders. The literature review has shown that the calculation of heat flow through gas-powder systems is highly developed. One major weakness in the calculational procedures is the absence of structural features for the powders, which are invariably characterized as regular arrays of spheres or cubes rather than random irregularly shaped particles. The effect of particle size distribution on the shape and size of void spaces is not modeled, although it affects the thermal conductivity of the gas. Calculations of thermal performance based on simplified descriptions of the porosity distribution can be used to show the dependence of thermal resistance on interstitial gas pressure. The literature reviewed in this report provides a basis for predicting the interstitial gas pressure at which

thermal conductivity begins to increase. The objective is to design filler material for powder insulation systems with ultrafine void spaces that will permit pressure increases without dramatic thermal conductivity increases.

26503 (ETSU-S–1353) **Daylighting in the building regulations: a feasibility study.** Pickering, M.; Orrell, R. NBA Tectonics, London (United Kingdom). 1993. 98p. Order Number DE93504804. Source: OSTI; NTIS (US Sales Only).

The study has shown that on grounds of cost effectiveness and energy savings, there is a strong case for introducing new requirements into the Building Regulations that could set a minimum average efficacy for electric lighting and require lighting controls to be installed. The requirements would apply only to non-domestic buildings. A summary of the proposed regulatory measures, including their benefits and drawbacks, is given. These two measures would produce an estimated annual saving of 24% of the lighting energy used in non-domestic building compared to current practice. This saving would be effective from the time the Regulations came into operation. If the measures were introduced into the Building Regulation in 1993, then by 2030 the estimated annual savings in electricity consumption would be about 4,000 GWh a year (worth about 275 million pounds at todays prices and equivalent to a reduction of about 3.2 million tonnes of CO_2 a year). (author)

26504 (LBL–30508) **Residential energy use and conservation in Venezuela: Results and implications of a household survey in Caracas.** Figueroa, M.J.; Ketoff, A.; Masera, O. Lawrence Berkeley Lab., CA (United States). Oct 1992. 66p. Sponsored by Petroleos de Venezuela S.A. DOE Contract AC03-76SF00098. Order Number DE93015372. Source: OSTI; NTIS; GPO Dep.

This document presents the final report of a study of residential energy use in Caracas, the capital of Venezuela. It contains the findings of a household energy-use survey held in Caracas in 1988 and examines options for introducing energy conservation measures in the Venezuelan residential sector. Oil exports form the backbone of the Venezuelan economy. Improving energy efficiency in Venezuela will help free domestic oil resources that can be sold to the rest of the world. Energy conservation will also contribute to a faster recovery of the economy by reducing the need for major investments in new energy facilities, allowing the Venezuelan government to direct its financial investments towards other areas of development. Local environmental benefits will constitute an important additional by-product of implementing energy-efficiency policies in Venezuela. Caracas's residential sector shows great potential for energy conservation. The sector is characterized by high saturation levels of major appliances, inefficiency of appliances available in the market, and by careless patterns of energy use. Household energy use per capita average 6.5 GJ/per year which is higher than most cities in developing countries; most of this energy is used for cooking. Electricity accounts for 41% of all energy use, while LPG and natural gas constitute the remainder. Specific options for inducing energy conservation and energy efficiency in Caracas's residential sector include energy-pricing policies, fuel switching, particularly from electricity to gas, improving the energy performance of new appliances and customer information. To ensure the accomplishment of an energy-efficiency strategy, a concerted effort by energy users, manufacturers, utility companies, government agencies, and research institutions will be needed.

26505 (LBL–32380-Vol.1) **ASEAN-USAID buildings energy conservation project: Volume 1, Energy standards: Final report.** Levine, M.D. (Lawrence Berkeley Lab., CA (United States)); Busch, J.F. (eds.); Deringer, J.J. Lawrence Berkeley Lab., CA (United States). Jun 1992. 122p. Sponsored by Agency for International Development, Washington, DC (United States). DOE Contract AC03-76SF00098. Order Number DE93015245. Source: OSTI; NTIS; GPO Dep.

Mandatory or voluntary energy-efficiency standards for new or existing buildings can play an important role in a national program aimed at promoting energy conservation. Building codes and standards can provide a degree of control over design and building practices throughout the construction process, and encourage awareness of energy-conscious design. Studies in developed countries indicate that efficiency standards can produce energy reductions on the order of 20 to 40% or more. Within ASEAN, analyses of the savings potential from the proposed standards suggest that if implemented, these standards would produce savings over current new design practice of 19% to 24%. In this volume we provide an overview of the ASEAN-USAID project aimed at promulgating standards for energy efficiency in commercial buildings. The process of developing and implementing energy-efficiency standards for buildings can be subdivided into two key components: policy development; and technical and economic analysis. Each of these involves a number of steps and processes, as outlined in Figure 1-1. This volume describes the technical and economic analyses used to develop the proposed energy efficiency standards for four countries (Malaysia, Thailand, the Philippines, and Indonesia), and to refine an energy standard existing in Singapore since 1979. Though oriented toward the ASEAN region, the analysis methods described here are applicable in a range of settings, provided appropriate modifications are made for local building construction, climatic, economic, and political conditions. Implementation issues are not specifically addressed here; rather this volume is oriented towards the analytical work needed to establish or revise an energy standard for buildings.

26506 (LBL–32826) **Preliminary evaluation of the performance, water use, and current application trends of evaporative coolers in California climates.** Huang, Y.J.; Hanford, J.W.; Wu, H.F. Lawrence Berkeley Lab., CA (United States). Sep 1992. 44p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. Order Number DE93015235. Source: OSTI; NTIS; GPO Dep.

This paper describes the latest results of an ongoing analysis investigating the potential for evaporative cooling as an energy-efficient alternative to standard air-conditioning in California residences. In particular, the study uses detailed numerical models of evaporative coolers linked with the DOE-2 building energy simulation program to study the issues of indoor comfort, energy and peak demand savings with and without supplemental air-conditioning and consumptive water use. In addition, limited surveys are used to assess the current market availability of evaporative cooling in California, typical contractor practices and costs, and general acceptance of the technology among engineers, contractors, and manufacturers. The results show that evaporative coolers can provide significant energy and peak demand savings in California residences, but the impact of the increased indoor humidity on human comfort remains an unanswered question that requires further research and clarification. Evaluated against ASHRAE comfort standards developed primarily for air-conditioning both direct and two-stage evaporative coolers would not maintain comfort at peak cooling conditions due to excessive humidity. However, using bioclimatic charts that place human comfort at the 80% relative humidity line, the study suggests that direct evaporative coolers will work in mild coastal climates, while two-stage models should provide adequate comfort in Title 24 houses throughout California, except in the Imperial Valley. The study also shows that evaporative coolers will increase household water consumption by less than 6% on an annual basis, and as much as 23% during peak cooling months, and that the increases in water cost are minimal compared to the electricity savings. Lastly, a survey of engineers and contractors revealed generally positive experiences with evaporative coolers, with operational cost savings, improved comfort, unproved air quality as the primary benefits in their use.

26507 (LBL–33075) **Impact assessment and performance targets for lighting and envelope systems.** Sullivan, R.; Lee, E.S.; Selkowitz, S. Lawrence Berkeley Lab., CA (United States). Jun 1992. 41p. Sponsored by USDOE, Washington, DC (United States); California Inst. for Energy Efficiency, Berkeley, CA (United States). DOE Contract AC03-76SF00098. (BS–295). Order Number DE93015233. Source: OSTI; NTIS; GPO Dep.

Electric lighting loads and cooling from solar heat gains and from lights are the two largest components of peak demand in commercial buildings. The most cost effective demand side management solutions are generally those that directly reduce or eliminate these loads. Existing technologies can provide modest reductions, however they are typically applied an a piecemeal manner that yields

less than optimal results. The full potential of existing technologies will be realized when they are commercially available in an integrated package easily specifiable by architects and engineers. Emerging technologies can also be developed to provide even greater savings and extend the savings over a greater portion of the building floor area. This report assesses achievable energy and peak demand performance in California commercial buildings with technologies available today and in the future. We characterize energy performance over a large range of building envelope and lighting conditions, both through computer simulation models and through case study measured data, and subsequently determine reasonable energy targets if building design were further optimized with integrated systems of current or new technologies. Energy targets are derived from the study after consideration of industry priorities, design constraints, market forces, energy code influence, and the state of current building stock.

26508 (LBL–33201) **Technology reviews: Shading systems.** Schuman, J.; Rubinstein, F.; Papamichael, K.; Beltran, L.; Lee, E.S.; Selkowitz, S. Lawrence Berkeley Lab., CA (United States). Sep 1992. 11p. Sponsored by USDOE, Washington, DC (United States); California Inst. for Energy Efficiency, Berkeley, CA (United States). DOE Contract AC03-76SF00098. Order Number DE93015240. Source: OSTI; NTIS; GPO Dep.

We present a representative review of existing, emerging, and future technology options in each of five hardware and systems areas in envelope and lighting technologies: lighting systems, glazing systems, shading systems, daylighting optical systems, and dynamic curtain wall systems. The term technology is used here to describe any design choice for energy efficiency, ranging from individual components to more complex systems to general design strategies. The purpose of this task is to characterize the state of the art in envelope and lighting technologies in order to identify those with promise for advanced integrated systems, with an emphasis on California commercial buildings. For each technology category, the following activities have been attempted to the extent possible: Identify key performance characteristics and criteria for each technology. Determine the performance range of available technologies. Identify the most promising technologies and promising trends in technology advances. Examine market forces and market trends. Develop a continuously growing in-house database to be used throughout the project. A variety of information sources have been used in these technology characterizations, including miscellaneous periodicals, manufacturer catalogs and cut sheets, other research documents, and data from previous computer simulations. We include these different sources in order to best show the type and variety of data available, however publication here does not imply our guarantee of these data. Within each category, several broad classes are identified, and within each class we examine the generic individual technologies that fall into that class.

26509 (LBL–33772) **Global residential appliance standards.** Turiel, I. (Lawrence Berkeley Lab., CA (US)); McMahon, J.E.; Lebot, B. Lawrence Berkeley Lab., CA (United States). Mar 1993. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-9306174–2: European Council for an energy-efficient economy summer study, Rungstedgaard (Denmark), 1-5 Jun 1993). Order Number DE93015045. Source: OSTI; NTIS; GPO Dep.

In most countries, residential electricity consumption typically ranges from 20% to 40% of total electricity consumption. This energy is used for heating, cooling, refrigeration and other end-uses. Significant energy savings are possible if new appliance purchases are for models with higher efficiency than that of existing models. There are several ways to ensure or encourage such an outcome, for example, appliance rebates, innovative procurement, and minimum efficiency standards. This paper focuses on the latter approach. At the present time, the US is the only country with comprehensive appliance energy efficiency standards. However, many other countries, such as Australia, Canada, the European Community (EC), Japan and Korea, are considering enacting standards. The greatest potential impact of minimum efficiency standards for appliances is in the developing countries (e.g., China and India), where saturations of household appliances are relatively low but growing rapidly. This paper discusses the potential savings that could be achieved from global appliance efficiency standards for refrigerators and freezers. It also could be achieved from global appliance efficiency standards for refrigerators and freezers. It also discusses the impediments to establishing common standards for certain appliance types, such as differing test procedures, characteristics, and fuel prices. A methodology for establishing global efficiency standards for refrigerators and freezers is described.

26510 (LBL–33945) **Simulating the daylight performance of fenestration systems and spaces of arbitrary complexity: The IDC method.** Papamichael, K.; Beltran, L. Lawrence Berkeley Lab., CA (United States). Apr 1993. 5p. Sponsored by USDOE, Washington, DC (United States); California Inst. for Energy Efficiency, Berkeley, CA (United States). DOE Contract AC03-76SF00098. (CONF-9308111–1: 3. international conference of the International Building Performance Simulation Association, Adelaide (Australia), 16-18 Aug 1993). Order Number DE93015177. Source: OSTI; NTIS; GPO Dep.

A new method to simulate the daylight performance of fenestration systems and spaces is presented. This new method, named IDC (Integration of Directional Coefficients), allows the simulation of the daylight performance of fenestration systems and spaces of arbitrary complexity, under any sun, sky and ground conditions. The IDC method is based on the combination of scale model photometry and computer-based simulation. Physical scale models are used to experimentally determine a comprehensive set of "directional illuminance coefficients" at reference points of interest, which are then used in analytical, computer-based routines, to determine daylight factors or actual daylight illuminance values under any sun, sky and ground conditions. The main advantage of the IDC method is its applicability to any optically complex environment. Moreover, the computer-based analytical routines are fast enough to allow for hourly simulation of the daylight performance over the course of an entire year. However, the method requires appropriate experimental facilities for the determination of the Directional Coefficients. The IDC method has been implemented and used successfully in inter-validation procedures with various daylight simulation computer programs. Currently, it is used to simulate the daylight performance of fenestration systems that incorporate optically comp1ex components, such as Venetian blinds, optically treated light shelves and light pipes.

26511 (LUTMDN-TMVK–3149) **Experimental investigation of a condensing boiler with a Thermomax burner and flue gas reheating.** Naeslund, M. Lund Univ. (Sweden). Dept. of Heat and Power Engineering. Mar 1993. 31p. Order Number DE93500689. Source: OSTI; NTIS.

Flue gas reheating in small gas fired condensing boilers provides an alternative to a corrosion resistant chimney liner. This report discusses reheating and how it can be coupled to the boiler, the building and the heating system. Experiments involving one of the suggested boiler designs are described. An experimental boiler was designed for this purpose. The boiler consists of a circular burner and a finned heat exchanger tube wound around the burner. Without reheating the boiler showed an efficiency of about 95 % at a 3.5-8 kW heat load. The efficiencies at the same loads, using reheating, were measured at 70-75 %. The low boiler efficiency with reheating can be explained by high heat losses. Since the cause for the heat losses is known no more tests were made, The efficiency can be considerably increased by added heat insulation. Too great a degree of reheating also accounted for a part of this low efficiency. The report ends with a couple of design criteria for the favourable operation of a small, gas fired condensing boiler using flue gas reheating: the criteria being limited to this design. (7 refs., 20 figs., 6 tabs.).

26512 (NEI-DK–1217) **Green plan of maintenance: Maintenance and resource savings in the cooperative housing association building at Bissensgade/Lundbyesgade, Aarhus.** Nellemann Raadgivende Ingenioerer og Planlaeggere A/S, Aarhus (Denmark). May 1991. 44p. (In Danish). Contract ENS-UVE-90.0119. Order Number DE93500337. Source: OSTI; NTIS.

The project's aim was to work out a step-by-step plan of maintenance for the Bissensgade/Lundbyesgade property based on an analysis of the best solutions in relation to available resources and

costs. The various methods for saving water, cutting down on heating and local management of household wastes are compared. The building was constructed in 1926 and is located in the center of the town. It contains 30 rented flats, each with 2-3 rooms plus a bathroom and a lavatory. It is served by a district heating plant. The current condition is described in addition to suggested methods of saving energy etc. Ways of persuading the inhabitants of the cost benefits of these initiatives are discussed. The actual plan of maintenance is described in detail. Elements of this plan, in addition to construction repairs, are thermal insulation, heat recovery in relation to water heating, and the use of solar energy as supplementary heating in the summer. (AB).

26513 (PNL–8705) **DOE standard compliance demonstration program: An office building example.** Bailey, S.A.; Keller, J.M.; Wrench, L.E.; Williams, C.J. Pacific Northwest Lab., Richland, WA (United States). Jun 1993. 59p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93017527. Source: OSTI; NTIS; GPO Dep.

The US Department of Energy (DOE) issued interim new building energy standards (10 CFR 435 1989) to achieve maximum energy efficiency in the designs of new buildings. DOE then entered into a project to demonstrate and assess the impact of these standards on the design community. One area of focus was a test to see how a less conventional design-focused building would meet the standards' requirements – DOE wanted to demonstrate that compliance with energy standards does not mean compromising the architectural intent of a building. This study, which was initiated at Pacific Northwest Laboratory (PNL), illustrated the process by which compliance with the standards can be proven for a highly "design-oriented" office building. The study also assessed the impact of the whole building simulation compliance alternatives on design. This report documents the compliance requirements, gives a description of the sample building chosen for the study, provides general guidance for the compliance process, documents the method of compliance that was undertaken for the sample building, presents the results of the study, and provides a recommendation on how the compliance requirements could be improved to reflect more realistic use types.

26514 (PNL–8715) **Results from an energy-efficient showerhead field study.** Warwick, W.M.; Bailey, S.A. Pacific Northwest Lab., Richland, WA (United States). Jun 1993. 68p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93017525. Source: OSTI; NTIS; GPO Dep.

In 1991 the Bonneville Power Administration (Bonneville) initiated research to determine the energy savings potential of energy-efficient showerheads, including a two-phase study by Pacific Northwest Laboratory (PNL). The PNL study focused on 154 homes monitored with end-use metering equipment. In the first phase of the study, PNL recruited participants from the homes, installed energy efficient showerheads, and collected occupant and site characteristics data. The second phase of the study is an analysis of the end-use load data to estimate energy use and savings from showerheads over a two-year period. This report presents the results from the first phase field study. Program results are based on the number of homes that participated in various aspects of the study. Among the 154 of homes selected for the study, 65% agreed to participate. Eighty-eight percent of these homes actually had their showerheads replaced. After 15 months, 94% of the homes where showerheads were installed still had at least one in place. Measure results are based on the number of showerheads that were installed. The 154 homes contained an estimated 240 showerheads that could have been replaced. Sixty-six percent of these showerheads were actually replaced. If only showers in participant homes are considered, 83% of the showerheads were replaced. Measure persistence at the end of 15 months was 94%. The water flow rate from existing showerheads averaged 3.2 gallons per minute (gpm) at participating sites. Average water pressure for city-supplied water was 66 pounds per square inch (psi). Water pressure at homes on wells was over 40% lower, which reduced savings potential. The energy-efficient showerheads had an average flow rate of 1.8 gpm. Observed water flow reductions of 1.4 gpm were obtained from retrofit of energy-efficient showerheads. In about 20% of the showers, water flows remained constant or actually increased after retrofit of energy-efficient showerheads.

26515 (PNL-SA–22528) **Sequestering carbon dioxide in industrial polymers: Building materials for the 21st century.** Molton, P.M.; Nelson, D.A. Pacific Northwest Lab., Richland, WA (United States). Jun 1993. 25p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93016087. Source: OSTI; NTIS; GPO Dep.

This study was undertaken to determine the possibility of developing beneficial uses for carbon dioxide as a key component for a large-volume building product. Such a use may provide an alternative to storing the gas in oceanic sinks or clathrates as a way to slow the rate of global warming. The authors investigated the concept that carbon dioxide might be used with other chemicals to make carbon-dioxide-based polymers which would be lightweight, strong, and economical alternatives to some types of wood and silica-based building materials. As a construction-grade material, carbon dioxide would be fixed in a solid, useful form where it would not contribute to global warming. With the probable imposition of a fuel carbon tax in industrialized countries, this alternative would allow beneficial use of the carbon dioxide and could remove it from the tax basis if legislation were structured appropriately. Hence, there would be an economic driver towards the use of carbon-dioxide-based polymers which would enhance their future applications. Information was obtained through literature searches and personal contacts on carbon dioxide polymers which showed that the concept (1) is technically feasible, (2) is economically defensible, and (3) has an existing industrial infrastructure which could logically develop it. The technology exists for production of building materials which are strong enough for use by industry and which contain up to 90% by weight of carbon dioxide, both chemically and physically bound. A significant side-benefit of using this material would be that it is self-extinguishing in case of fire. This report is the first stage in the investigation. Further work being proposed will provide details on costs, specific applications and volumes, and potential impacts of this technology.

26516 (PNWD–2131) **Aquifer thermal energy storage at Mid-Island postal facility: Phase 1 final report.** Marseille, T.J.; Armstrong, P.R.; Brown, D.R.; Vail, L.W.; Kannberg, L.D. Pacific Northwest Lab., Richland, WA (United States). May 1993. 156p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93016399. Source: OSTI; NTIS; GPO Dep.

The successful widespread commercialization of aquifer thermal energy storage (ATES) in the United States will depend on how experiences gained from early full-scale projects are used as guides in the design, installation, and operation of future projects. One early system, built in the mid-1980s, is the US Postal Service (USPS) Mid-Island Mail Processing Facility (MPF), in Melville, New York. The heating, ventilation, and air conditioning (HVAC) of the MPF's workroom is provided by an ATES system, which is operated year-round to provide a source for both heating and cooling, in combination with a triethylene glycol (TEG) liquid-desiccant system for humidity control. Because the facility affords a unique opportunity to study this innovative system, the US Department of Energy's (DOE) Pacific Northwest Laboratory (PNL) entered into agreements with the USPS, the US Geological Survey (USGS), and the New York State Energy Research and Development Authority (the Energy Authority) to assess the operation and performance of the system. Two essentially independent questions were to be addressed by the project. The first question was: "How does the MPF ATES/TEG technology compare to conventional technologies?" The second was: "What can be done to make operation of the USPS MPF more economical?" Modelling of the MPF ATES/TEG HVAC system and its loads helped to address both of these questions by showing how much energy is used by the different system components. This report is divided into six sections. Section 1 is an introduction. Section 2 provides system background. Section 3 describes PNL's technical performance assessment of the system. Section 4 discusses the life-cycle cost assessment. An operational assessment of the liquid-desiccant system is discussed in Section 5. Section 6 contains conclusions of this study.

26517 (REFR--93-9) **Stirling cycle heat pumps and refrigerators.** Lundqvist, P.G. Royal Inst. of Tech., Stockholm (Sweden). Dept. of Applied Thermodynamics and Refrigeration. 1993. 300p. Order Number DE93500857. Source: OSTI; NTIS.

This thesis is a theoretical and experimental study of the thermodynamics of the Stirling cycle, operating as a refrigerator or heat pump. The thesis shows that the Stirling cycle is able to compete with the vapour compression cycle, in terms of energy efficiency, at temperature lifts greater than 60 deg C. The benefits and the limitations of the Stirling cycle are thoroughly discussed. Several examples of design changes, and their influence on the performance, are given in the thesis. The optimum design of a refrigerator or heat pump, based on the Stirling cycle, differs substantially from the design of a Stirling engine or a low temperature Stirling refrigerator. One aim of this thesis is to clarify these differences with reference to the variety of losses that occur in real machinery. It is shown, experimentally as well as theoretically, that the temperature lift strongly influence the importance of the design parameters. Special interest has been given to the volume ratio. The most important losses in a low temperature lift Stirling refrigerator or heat pump are: temperature differences in the heat exchangers, and adiabatic cylinder losses (internal cycle temperature differences). It is shown that mechanical friction and unwanted heat conduction set a limit for the design changes necessary to avoid these losses. Any optimization process therefore needs to take these phenomena into consideration at an early stage. A simulation code, Stisim, has been developed, based on a modified adiabatic Stirling cycle analysis with partly decoupled losses. The code is compared with experimentally evaluated data for a modified V160 machine operated as a refrigerator. (120 refs., 136 figs.).

3202 Transportation

Refer also to citation(s) 26459, 26559, 26561

26518 (ETDE-IT--93-165) **Rational energy use in transportation sector: European Communities COST 307 action.** Merzagora, N. ENEA, Rome (Italy). Direzione Studi. Nov 1992. 145p. (In Italian). Order Number DE93799186. Source: OSTI; NTIS (US Sales Only).

COST (European Cooperation in Field of Scientific and Technological Research), a European Communities coordinated research organization founded in 1971, presents this final report on the rational use of energy in the European transportation sector. The report contains analyses comparing Member States' energy conservation policies directed towards energy efficiency improvements in key transportation sector subdivisions - light and heavy road vehicular transport, passenger and freight rail, and air transport. The parameters taken into account in the analyses include statistical data on: traffic (number of passengers, quantity of freight, distances travelled, etc.); relative energy consumption (global and unit values); fuel costs; and type, number, age and maintenance status of vehicles. The analyses also made use of computerized simulations of proposed energy conservation schemes to forecast expected socio-economic impacts, energy savings and reductions in air pollution.

26519 (ORNL/FTR--4242) **Travel to London, England, to attend the sixth international conference on road traffic monitoring and control and to visit traffic control centers in Greater London area to assess their capabilities and operations: Foreign trip report, March 20, 1992--May 1, 1992.** Rathi, A.K. Oak Ridge National Lab., TN (United States). 12 May 1992. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93011082. Source: OSTI; NTIS (US Sales Only); GPO Dep.

I attended the Sixth International Conference on Road Traffic Monitoring and Control organized by The Institution of Electrical Engineers (IEE) in London. England. I also visited the traffic control centers in Central and East London and saw a demonstration of AUTOGUIDE, an in-vehicle route guidance system. The AUTOGUIDE demonstration included a drive through Central London with the help of an on-board navigation and route guidance system. Useful information was obtained on the current status of the AUTOGUIDE and similar projects in Europe. Most of the forty-seven (47) papers presented at the conference were of high quality and contained new and innovative approaches to road traffic monitoring and control. Several pavers were of great interest to ongoing work at the Oak Ridge National Laboratory on the Intelligence Vehicle Highway Systems (IVHS) and Chemical Stockpile Emergency Preparedness Program (CSEPP) projects. The papers in the sessions on Urban Networks, Driver Information, and Imaging were of particular interest. In many instances, the material presented clearly indicated the advanced state of technology applications in traffic management in Europe (e.g., the Dutch Fog-Detection Experiments and the M25 Motorway control system). There were over a dozen exhibitors in the conference. Noteworthy among the exhibits were the TrafficMaster system, a weigh-in-motion system, and the ELTRACS system. The TrafficMaster system is a portable traffic information system which covers an area of approximately 35 miles radius from Central London.

26520 (ORNL/TM--12361) **1990 Nationwide Truck Activity and Commodity Survey selected tabulations: Summary report.** Oak Ridge National Lab., TN (United States). Jun 1993. 124p. Sponsored by Department of Transportation, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93015360. Source: OSTI; NTIS; GPO Dep.

The Nationwide Truck Activity and Commodity Survey (NTACS) provides detailed activity data for a sample of trucks covered in the 1987 Truck Inventory and Use Survey (TIUS) for days selected at random over a 12-month period ending in 1990. The NTACS was conducted by the US Bureau of the Census for the US Department of Transportation (DOT). A Public Use File for the NTACS was developed by Oak Ridge National Laboratory (ORNL) under a reimbursable agreement with the DOT. The content of the Public Use File and the detailed design of the NTACS are described in the ORNL Report "Technical Documentation for the 1990 Nationwide Truck Activity and Commodity Survey Public Use File". (1992). ORNL Technical Report No. TM-12188, Oak Ridge National Laboratory, Oak Ridge, TN 37831. The main purpose of this summary report is to provide selected tables based on the public use file.

3203 Industrial and Agricultural Processes

Refer also to citation(s) 25692, 26049, 26103, 26429, 26436, 26517, 26556, 27600, 27625, 28156

26521 (ANL/EAIS/TM--96) **Modeling plant-level industrial energy demand with the Manufacturing Energy Consumption Survey (MECS) database and the Longitudinal Research Database (LRD).** Boyd, G.A.; Neifer, M.J.; Ross, M.H. Argonne National Lab., IL (United States). Aug 1992. 59p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. Order Number DE93017524. Source: OSTI; NTIS; GPO Dep.

This report discusses Phase 1 of a project to help the US Department of Energy determine the applicability of the Manufacturing Energy Consumption Survey (MECS) database and the Longitudinal Research Database (LRD) for industrial modeling and analysis. Research was conducted at the US Bureau of the Census; disclosure of the MECS/LRD data used as a basis for this report was subject to the Bureau's confidentiality restriction. The project is designed to examine the plant-level energy behavior of energy-intensive industries. In Phase 1, six industries at the four-digit standard industrial classification (SIC) level were studied. The utility of analyzing four-digit SIC samples at the plant level is mixed, but the plant-level structure of the MECS/LRD makes analyzing samples disaggregated below the four-digit level feasible, particularly when the MECS/LRD data are combined with trade association or other external data. When external data are used, the validity of using value of shipments as a measure of output for analyzing energy use can also be examined. Phase 1 results indicate that technical efficiency and the distribution of energy intensities vary significantly at the plant level. They also show that the six industries exhibit monopsony-like behavior; that is, energy prices vary significantly at the plant level, with lower prices being correlated with a higher level of energy consumption. Finally, they show to what degree selected energy-intensive products are manufactured outside their primary industry.

26522 (EGG–2698) **Research and engineering assessment of biological solubilization of phosphate.** Rogers, R.D.; McIlwain, M.E.; Losinski, S.J.; Taylor, D.D. EG and G Idaho, Inc., Idaho Falls, ID (United States). Mar 1993. 46p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. Order Number DE93010368. Source: OSTI; NTIS; GPO Dep.

This research and engineering assessment examined a microbial phosphate solubilization process as a method of recovering phosphate from phosphorus containing ore compared to the existing wet acid and electric arc methods. A total of 860 microbial isolates, collected from a range of natural environments were tested for their ability to solubilize phosphate from rock phosphate. A bacterium (Pseudomonas cepacia) was selected for extensive characterization and evaluation of the mechanism of phosphate solubilization and of process engineering parameters necessary to recover phosphate from rock phosphate. These studies found that concentration of hydrogen ion and production of organic acids arising from oxidation of the carbon source facilitated microbial solubilization of both pure chemical insoluble phosphate compounds and phosphate rock. Genetic studies found that phosphate solubilization was linked to an enzyme system (glucose dehydrogenase). Process-related studies found that a critical solids density of 1% by weight (ore to liquid) was necessary for optimal solubilization. An engineering analysis evaluated the cost and energy requirements for a 2 million ton per year sized plant, whose size was selected to be comparable to existing wet acid plants.

26523 (ETDE-IT–93-155) **Energy efficiency technologies and experiences in industrial plant.** Di Bartolomeo, M.; Palazzi, G. ENEA, Casaccia (Italy). Area Energetica. 1992. 23p. (CONF-9210372–2: Workshop on the rational use of energy, Budapest (Hungary), 27-29 Oct 1992). Order Number DE93799183. Source: OSTI; NTIS (US Sales Only).

The ENEA (Italian Agency for Energy, New Technologies and the Environment) Energy Plant Department supports the introduction of advanced technology in industrial processes to improve the rational use of energy and decrease consumption. This paper reports on some recent Energy Plant Department research project results. The projects included: digital image processing techniques in the forging process (a system, coupling a telecamera with microprocessor for image processing was developed for remote measuring of the forged piece coming from the furnace); a spool piece for multiphase flow-rate measurement based on two gamma densitometers, a Venturi tube, a capacitive probe and two differential pressure gauges (the goal is to monitor the three phases (oil-water-gas) flow in the submarine pipeline); a feed-water pump cavitation control system using noise analysis of pressure fluctuations and heated thermocouples (the system is now working in an Italian thermoelectrical power plant); an automated visual inspection system for electric railroad cables to improve safety and reliability of railway transportation service (the system couples CCD cameras with a computer, and is able to measure the residual cable thickness with an accuracy of 0.25 mm with a 36 km/h inspection speed); new hydraulic mini-turbine test to characterize the velocity field in the machine with a laser doppler anemometer; tests in a large scale facility to increase turbine efficiency; tests in a high temperature facility to improve components and materials working at temperatures of more than 1500 degrees C.

26524 (ETDE-IT–93-158) **Cementation of toxis sludges: Italian experience.** Balzamo, S.; De Angelis, G.; De Poli, F. ENEA, Casaccia (Italy). 1992. 21p. (CONF-921020–4: Cement industry solutions to waste management, Calgary (Canada), 7-9 Oct 1992). Order Number DE93799184. Source: OSTI; NTIS (US Sales Only).

Research work is being undertaken at ENEA (Italian Agency for Energy, New Technologies and the Environment) laboratories about the stabilization by Portland cement of different types of sludges, like those arising from electroplating, tanning and pottery manufactures. Each waste material was tested in order to evaluate the environmental impact and predict long-term behaviour. An interesting experience concerning the re-use of products from the stabilization of polluted sludges dredged from a harbour in the North of Italy, is described. Tests concerning the characterization of such products proved successful. In particular the retention capacity of toxic elements was demonstrated. A detailed proposal regarding the acceptance criteria of sludge materials is also presented.

26525 (ETDE/JP-mf–93798907) **Prospect on new energies.: Effective energy utilization.** Institute of Applied Energy, Tokyo (Japan). Mar 1991. 25p. (In Japanese). Order Number DE93798907. Source: OSTI; NTIS; Available from The Institute of Applied Energy, 14-2, Nishishinbashi 1-chome, Minato-ku, Tokyo, Japan.

This paper reports surveys on effective energy utilization carried out by the General Energy Engineering Research Institute of Japan. According to an estimate on supply of oil substituting energies as determined in a Japanese Government Cabinet meeting in 1990, the total supply amount in 2000 would reach 594 million kl (1 liter equals 9,250 kcal), and the final energy consumption would amount to 391 million kl (converted to crude oil). An effective utilization rate of the energies supplied to the entire society is about one third, which has fallen instead of increase in power demand. Waste heats must be utilized sufficiently. Energy consumption in major countries remains at an annual average rate of 1% of their GNP. Improvement for energy utilization rate must be addressed to a more economically optimum point. That the energy price has been stabilized now, conservation of resources and energies must be stressed again urgently to deal with the simultaneous occurrence of the global warming problem. It is doubtful whether the idea of carbon taxation or carbon dioxide taxation applied to the manufacturing industries would make a turning point to energy conservation, or how much effect the taxation system could bring about in the transportation and consumer sectors. 6 refs., 16 figs., 6 tabs.

26526 (ETSU-B–1305-P1) **An analysis of landfill charges in the UK.** Burnett, J.S. Aspinwall and Co., Shrewsbury (United Kingdom). 1992. 71p. Order Number DE93504800. Source: OSTI; NTIS (US Sales Only).

This analysis of landfill charges is one component of a broader consultancy for the Energy Technology Support Unit (ETSU) studying the strategic options for energy from waste schemes within the private waste industry. This survey is of landfill gate charges only, and excludes the cost of collection and transport to the site. A telephone survey of public authorities and private waste disposal companies in each county in England and Wales was carried out between January and September 1991. Public authority charges were obtained from the waste disposal authorities, and private waste contractor charges were obtained by contacting companies listed in the National Waste Disposal Contractors Membership Directory and the Aspinwall SITEFILE Digest (1991). (author)

26527 (KCL-RAINA–6) **Energy efficient paper production.** Komppa, A. (ed.). Finnish Pulp and Paper Research Inst., Espoo (Finland). 1991. 184p. (In Finnish). (CONF-9111321–: RAINA-seminar, Espoo (Finland), 14 Nov 1991). Order Number DE93500421. Source: OSTI; NTIS.

RAINA Research Programme.

The goal of the five-year RAINA-program is to optimize the utilization of energy in the papermaking process. So far ten research projects and four joint development projects have been financed by the program. The ongoing projects presented at the third RAINA-seminar on 14 November 1991 were the following ones: The effect of vacuum on dewatering and the structure of paper at the wire section. Determination of the vacuum requirements of the paper machine. Improving heat and power economy of a paper machine equipped with turbine-driven vacuum system. Optimization of the low pressure level of the press suction roll at the paper machine. Development of a dryer section simulation model meeting the requirements of the paper machine operating personnel. Optimization of press drying from the energy and quality point of view. Measurement of paper quality properties. Development of low- consistency beating of chemical pulps. Energy efficient use of IR dryers. This publication also contains a list of the publications within the program.

26528 (KCP–613-5138) **Pollution prevention through total quality.** Stoltz, D.L.; Byrant, M.G.; Eggers, D.M.; Gough, R.W.; Schlosberg, W.H. Allied-Signal Aerospace Co., Kansas City, MO (United States). Kansas City Div. May 1993. 16p. Sponsored by

USDOE, Washington, DC (United States). DOE Contract AC04-76DP00613. (CONF-930483–7: 9. waste minimization and pollution prevention conference, San Francisco, CA (United States), 13-15 Apr 1993). Order Number DE93013814. Source: OSTI; NTIS; GPO Dep.

Application of Total Quality to AlliedSignal Inc., Kansas City Division's (KCD) Pollution Prevention Program has created a dynamic and focused effort to significantly reduce process inefficiencies and waste generation. KCD is demonstrating TQ's usefulness by empowering associates and obtaining their buy-in and ownership of pollution prevention principles. Specific pollution prevention working groups include: establishing a comprehensive recycling process; (2) capitalizing on Environmentally Conscious Manufacturing (ECM) expertise; and (3) encouraging the internal implementation of ECM. TQ produces the performance results that promote and sustain plant-wide pollution prevention goals and activities. KCD uses AlliedSignall's nine step "Process Improvement Problem/Solving Model" (Appendix A). Although this program only formally began within the past year, many of the tools have been used over the last eight years to achieve pollution prevention objectives. This paper focuses on the new attitude and gives examples of how each of the nine steps is being used in the KCD Pollution Prevention Program. This paper describe s each step of the process and provides specific pollution prevention examples.

26529 (KCP–613-5172) **Rapid Intelligent Inspection Process Definition for dimensional measurement in advanced manufacturing.** Brown, C.W. Allied-Signal Aerospace Co., Kansas City, MO (United States). Kansas City Div. Mar 1993. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00613. (CONF-9303165–1: Advanced technology program proposal meeting, Arlington, TX (United States), 19 Mar 1993). Order Number DE93011271. Source: OSTI; NTIS; GPO Dep.

The Rapid Intelligent Inspection Process Definition (RIIPD) project is an industry-led effort to advance computer integrated manufacturing (CIM) systems for the creation and modification of inspection process definitions. The RIIPD project will define, design, develop, and demonstrate an automated tool (i.e., software) to generate inspection process plans and coordinate measuring machine (CMM) inspection programs, as well as produce support information for the dimensional measurement of piece parts. The goal of this project is to make the inspection and part verification function, specifically CMM measurements, a more effective production support tool by reducing inspection process definition flowtime, creating consistent and standard inspections, increasing confidence of measurement results, and capturing inspection expertise. This objective is accomplished through importing STEP geometry definitions, applying solid modeling, incorporating explicit tolerance representations, establishing dimensional inspection,techniques, embedding artificial intelligence techniques, and adhering to the Dimensional Measuring Interface Standard (DMIS) national standard.

26530 (LA–12532-MS) **Metal-ion recycle technology for metal electroplating waste waters.** Sauer, N.N.; Smith, B.F. Los Alamos National Lab., NM (United States). Jun 1993. 55p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93016006. Source: OSTI; NTIS; GPO Dep.

As a result of a collaboration with Boeing Aerospace, the authors have begun a program to identify suitable treatments or to develop new treatments for electroplating baths. The target baths are mixed-metal or alloy baths that are being integrated into the Boeing electroplating complex. These baths, which are designed to replace highly toxic chromium and cadmium baths, contain mixtures of two metals, either nickel-tungsten, nickel-zinc, or zinc-tin. This report reviews the literature and details currently available on emerging technologies that could affect recovery of metals from electroplating baths under development by Boeing Aerospace. This literature survey summarizes technologies relevant to the recovery of metals from electroplating processes. The authors expanded the scope to investigate single metal ion recovery technologies that could be applied to metal ion recovery from alloy baths. This review clearly showed that the electroplating industry has traditionally relied on precipitation and more recently on electrowinning as its waste treatment methods. Despite the almost ubiquitous use of precipitation to remove contaminant metal ions from waste electroplating baths and rinse waters, this technology is clearly no longer feasible for the electroplating industry for several reasons. First, disposal of unstabilized sludge is no longer allowed by law. Second, these methods are no longer adequate as metal-removal techniques because they cannot meet stringent new metal discharge limits. Third, precious resources are being wasted or discarded because these methods do not readily permit recovery of the target metal ions. As a result, emerging technologies for metal recovery are beginning to see application to electroplating waste recycle. This report summarizes current research in these areas. Included are descriptions of various membrane technologies, such as reverse osmosis and ultrafiltration, ion exchange and chelating polymer technology, and electrodialysis.

26531 (NEI-DK–1218) **Cooling needs and energy consumption in compressor-cooled seed potatoes.** Rasmussen, R. Bioteknologisk Inst., Kolding (Denmark). 1992. 30 p.p. (In Danish). Order Number DE93500331. Source: OSTI; NTIS.

The report shows that conditions such as storage volume, insulation, placing and defrosting methods have a significant influence on cooling needs and energy consumption related to the storage of seed potatoes. An average consumption of 30-40 kWh per ton per season is realistic where optimum storage conditions are achieved. With unsatisfactory conditions energy consumption would be twice as great. Energy consumption becomes much higher if storage facilities are poorly constructed or controlled, or if operational periods are too long. The background for these conclusions is described in some detail and illustrated with tables. (AB).

26532 (ORNL/FTR–4112) **Travel to The Netherlands for activities of the International Energy Agency's Heat Pump Centre: Foreign trip report, October 11–19, 1991.** Broders, M.A. Oak Ridge National Lab., TN (United States). 23 Oct 1991. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93011085. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The traveler, serving as Delegate from the United States Heat Pump Centre National Team, participated in the activities of the third IEA-HPC Working Team meeting. Highlights of this meeting included development of a 1992 IEA-HPC work plan, review and discussion of 1991 IEA-HPC activities and accomplishments, and introduction of the Italian National Team. The traveler, also serving as Delegate from the United States CADDET National Team, participated in the activities of the annual IEA-CADDET Working Team meeting. Highlights of this meeting included a workshop that introduced the most recent version of the CADDET Register and its database management system, a status review of recent and current IEA-CADDET activities, and discussion of future plans for CADDET Analyses, Newsletter Topics, Brochure production, and Register input.

26533 (ORNL/Sub–86-22044/2) **Development of a zirconia-mullite based ceramic for recuperator applications: DOE/ORNL Ceramic Technology Project.** Gonzalez, J.M. (GTE Products Corp., Towanda, PA (United States)). Oak Ridge National Lab., TN (United States); GTE Products Corp., Towanda, PA (United States). Dec 1992. 57p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93013451. Source: OSTI; NTIS; GPO Dep.

GTE Products Corporation developed a compact ceramic high temperature recuperator for recovering heat from relatively clean exhaust gases at temperatures up to 2500F. The DOE program allowed GTE to improve the technical and economic characteristics of the recuperator and stimulate industrial acceptance of the recuperator as an energy-saving technology. From January 1981 to December 1984, 561 recuperators were installed by GTE on new or retrofitted furnaces. With over 1200 units sold commercially between 1981 and 1990, GTE has documented the effect (long and short term) of corrosive attack from alkalies and lead. One objective of this contract was to develop Z-1000 a zirconia-mullite mixed oxide ceramic for use in ceramic recuperator applications susceptible to corrosion. To first and second pass of the ceramic recuperator would utilize the current cordierite-mixed-oxide ceramic. A Z-1000 matrix element would be used in the preheated air side's third pass

(exhaust inlet). Thermal stresses on Z-1000 cross flow module could be minimized by selecting appropriate heat transfer surface areas for each pass. A large surface area for first and second pass (cordierite section) could provide for sufficient heat transfer for 50% effectiveness. A surface area that generates minimal heat transfer in the third pass (Z-1000) section is envisioned. Heat transferred in this section reduces the differential temperature across the matrix and the thermal stresses. Hence, thermal shock resistance of the material in the third pass becomes less critical; however, its corrosion resistance must be sufficient to withstand corrosive attack. This modular design could utilize a field repairable, disposable matrix. This report is concerned with process technology development for fabricating such a matrix, and a series of corrosion tests that established the potential corrosion resistance of the Z-1000 ceramic.

26534 Conversion of hazardous materials using supercritical water oxidation. Rofer, C.K.; Buelow, S.J.; Dyer, R.B.; Wander, J.D. To Dept. of Energy. 29 Mar 1991. USA patent application 7-677,738. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93008232. Source: OSTI; NTIS; GPO Dep.

A process for destruction of hazardous materials in a medium of supercritical water without the addition of an oxidant material. The hazardous material is converted to simple compounds which are relatively benign or easily treatable to yield materials which can be discharged into the environment. Treatment agents may be added to the reactants in order to bind certain materials, such as chlorine, in the form of salts or to otherwise facilitate the destruction reactions.

26535 (PNL–8483) **Impact evaluation of an Energy $avings Plan project at Holnam Incorporated.** Brown, D.R.; Spanner, G.E. Pacific Northwest Lab., Richland, WA (United States). May 1993. 21p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93014863. Source: OSTI; NTIS; GPO Dep.

This impact evaluation of four energy conservation measures (ECMs) that were recently installed at Holnam Incorporated (Holnam) was conducted for the Bonneville Power Administration (Bonneville) as part of an evaluation of its Energy $avings Plan (E$P) Program. The Program makes acquisition payments to firms that install energy conservation measures in their industrial processes. The objective of this impact evaluation was to assess how much electrical energy is being saved at Holnam as a result of the E$P and to determine how much the savings cost Bonneville and the region. The impact of the ECMs was evaluated with a combination of engineering analysis, financial analysis, site visit and interview, and review of previous program submittals (Holnam's Proposals and Completion Reports). The four ECMs were all electronic power control devices that replaced less efficient technologies for controlling power to the kiln drive motors, cooler grate drive motors, cooler fan motors, and kiln stack gas precipitators. Energy savings from this project are expected to be 1,782,000 kWh/yr or 0.20 average megawatts. On a unit production basis, this project will save 3.4 kWh/ton of cement, based on Holnam's projected average annual future production rate. The four ECMs cost a total of $248,232 to install, and Holnam received payment of $115,615 from Bonneville for the acquisition of energy savings. Program administrative costs incurred by Bonneville, Pacific Northwest Laboratory (PNL), and Seattle City Light (SCL) were estimated to be $29,362. The real levelized cost (1992 $) of these energy savings to Bonneville will be 6.2 mills/kWh over the project's expected 15-year life, and the real levelized cost (1992 $) to the region will be 14.1 mills/kWh. Based on expected ECM installation costs and energy savings benefits alone, none of the four ECMs would have been implemented by Holnam without the E$P acquisition payment.

26536 (PNL–8484) **Impact evaluation of an adjustable speed drive installed at Ball-InCon Glass Packaging Corporation under the Energy $avings Plan.** Spanner, G.E.; Sullivan, G.P. Pacific Northwest Lab., Richland, WA (United States). May 1993. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93015684. Source: OSTI; NTIS; GPO Dep.

This impact evaluation of an adjustable speed drive that was recently installed at Ball-InCon Glass Packaging Corporation (Ball-InCon) was conducted for the Bonneville Power Administration (Bonneville) as part of an evaluation of its Energy $avings Plan (E$P) Program. The Program makes acquisition payments to firms that install energy conservation projects in their industrial processes. The objective of this impact evaluation was to assess how much electrical energy is being saved at Ball-InCon as a result of the E$P and to determine how much the savings cost Bonneville and the region. The impact of the project was evaluated with a combination of engineering analysis, financial analysis, interviews, and submittal reviews (Ball-InCon's Abstract, Proposal, and Completion Report). The project consists of switching from inlet guide vanes to adjustable frequency drives for 10 motors that provide cooling air to glass container molds. Based on this impact evaluation, energy savings from this project are expected to be 1,711,500 kWh/yr, or about 0.20 average megawatts. On a per-ton basis, this project will save approximately 7.8 kWh/ton of glass produced. The project cost $182,834 to install, and Ball-InCon received payment of $95,581 from Bonneville for the acquisition of energy savings. The real levelized cost of these energy savings to Bonneville is 5.2 mills/kWh over the projects's assumed 15-year life, and the levelized cost to the region is 10.7 mills/kWh in 1992 dollars, not including transmission and distribution effects. This project would not have been implemented without the acquisition payment from Bonneville, so all of the energy savings can be attributed to the E$P.

26537 (PNL-SA–22461) **Advanced recycling and research complexes: A second strategic use for installations on the base closure list.** Walter, D.W.; Kuusinen, T.L.; Beck, J.E. Pacific Northwest Lab., Richland, WA (United States). May 1993. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-930570–3: 2. annual Federal environmental restoration conference and exhibition, Washington, DC (United States), 25-27 May 1993). Order Number DE93015674. Source: OSTI; NTIS; INIS; GPO Dep.

Obstacles currently facing the solid waste recycling industry are often related to a lack of public and investor confidence, issues of profitability and liability, and insufficient consumer identification with products made from recycled materials. Resolution of these issues may not be possible without major changes in the way the solid waste recycling business is structured. At the same time, we are faced with opportunities which will not likely recur in our lifetimes: access to educated, well trained work forces; and large tracts of land that are contiguous with metropolitan areas and are developed for heavy industry and transportation. Military installations are being converted to civilian use just in time to serve as important a role in our national resource conservation policy. The future of recycling in North America converges with the future of selected bases on the closure list and takes the form of converting these bases into Advanced Recycling and Research Complexes. The premise is simple: use these strategically-located facilities as industrial parks where a broad range of secondary wastes are separated, refined, or converted and made into new products on site. The wastes would include municipal solid waste (MSW), demolition waste, landscape trimmings, used tires, scrap metal, agricultural waste, food processing waste, and other non-hazardous materials. The park would consist of separation and conversion facilities, research and product standards laboratories, and industries that convert the materials into products and fuels. Energy conversion systems using some waste streams as fuel could be located at the park to supplement energy demands of the industrial operations. The strategic co-location of the resource providers and user industries would minimize transportation costs.

26538 (SAND–93-8235) **Process Waste Assessment, Mechanics Shop.** Phillips, N.M. Sandia National Labs., Livermore, CA (United States). May 1993. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DR00789. Order Number DE93016048. Source: OSTI; NTIS; GPO Dep.

This Process Waste Assessment was conducted to evaluate hazardous wastes generated in the Mechanics Shop. The Mechanics Shop maintains and repairs motorized vehicles and equipment on the SNL/California site, to include motorized carts, backhoes, street sweepers, trash truck, portable emergency generators, trencher,

portable crane, and man lifts. The major hazardous waste streams routinely generated by the Mechanics Shop are used oil, spent off filters, oily rags, and spent batteries. The used off and spent off filters make up a significant portion of the overall hazardous waste stream. Waste oil and spent batteries are sent off-site for recycling. The rags and spent on filters are not recycled. They are disposed of as hazardous waste. Mechanics Shop personnel continuously look for opportunities to minimize hazardous wastes.

26539 (TVA-Bull-Y-229) **Environmental realities in the 90's: Proceedings.** Tennessee Valley Authority, Muscle Shoals, AL (United States). [1993]. 186p. Sponsored by Tennessee Valley Authority, Knoxville, TN (United States). (CONF-9208220--: Environmental realities in the the '90s: TVA's agricultural/environmental conference, St. Louis, MO (United States), 26 Aug 1992). Order Number DE93014193. Source: OSTI; NTIS.

This report is a compilation of proceedings of the TVA's Agricultural/Environmental Conference held in St. Louis, Missouri August 26–28, 1992. Topics discussed include environmental concerns, agriculture, and various legislation and regulations.

26540 (TVA-Circ.–Z-325) **Utilization of by-product ammonium sulfate.** Boles, J.L. Tennessee Valley Authority, Muscle Shoals, AL (United States). [1992]. 16p. Sponsored by Tennessee Valley Authority, Knoxville, TN (United States). (CONF-9210352–1: Annual meeting of the fertilizer industry round table, Baltimore, MD (United States), 26-28 Oct 1992). Order Number DE93014146. Source: OSTI; NTIS.

Sulfur is generally referred to as a secondary plant nutrients but it actually ranks in importance with nitrogen and phosphorous in protein synthesis. It is also an integral part of vitamins and enzymes essential to life. Soils in many areas of the world today are deficient in sulfur and soil sulfur reserves are being rapidly depleted. To address growing agronomic needs for sulfur, TVA's National Fertilizer and Environmental Research Center (NFERC) has been committed to development of technologies to produce low-cost sulfur-containing fertilizers since the mid 1970's. In the late 1970's and early 1980's, NFERC developed and demonstrated a 29-0-0-5S urea-ammonium sulfate (UAS) suspension. In 1984, NFERC developed and later patented a new family of nitrogen-sulfur (NS) suspensions to replace the earlier UAS suspension with more versatile, better quality products made by a simpler, more economical process. NFERC's current endeavors involve development of technologies for successful utilization of low-quality, by-product ammonium sulfate (AS) in the fertilizer industry, which is the subject of this paper. NFERC's current focus on utilization of by-product AS centers around the economic and environmental aspects of these technologies as the primary rationale for development, since the needs for sulfur in soils is now generally well known and sulfur application is common and now charged for in many areas.

26541 (WHC-SA–1904) **Recycling and surplus chemical programs.** Harper, T.J. Westinghouse Hanford Co., Richland, WA (United States). May 1993. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (CONF-930483–11: 9. waste minimization and pollution prevention conference, San Francisco, CA (United States), 13-15 Apr 1993). Order Number DE93016477. Source: OSTI; NTIS; INIS; GPO Dep.

In 1988, 45 years of defense production came to a close at the US Department of Energy (DOE) Hanford Site. The mission of the Hanford Site was formally changed to environmental restoration and remediation. Westinghouse Hanford Company (WHC) is the management and operations (M&O) contractor leading the cleanup. Within the framework of future Site cleanup, Hanford recycling and surplus chemical programs are making a viable contribution today to waste minimization, diversion of materials from the waste stream, and setting a standard for future operations. This paper focuses on two successful efforts: paper recycling and surplus chemical sales.

26542 (WINCO–11914) **Implementation of the hazardous debris rule.** Sailer, J.E. Westinghouse Idaho Nuclear Co., Inc., Idaho Falls, ID (United States). 5 Jan 1993. 44p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-84ID12435. (CONF-9202180–1: Environmental regulations course for Federal Facilities and Government contractors, Idaho Falls, ID (United States), 8-10 Feb 1992). Order Number DE93015660. Source: OSTI; NTIS; INIS; GPO Dep.

Hazardous debris includes objects contaminated with hazardous waste. Examples of debris include tree stumps, timbers, boulders, tanks, piping, crushed drums, personal protective clothing, etc. Most of the hazardous debris encountered comes from Superfund sites and other facility remediation, although generators and treaters of hazardous waste also generate hazardous debris. Major problems associated with disposal of debris includes: Inappropriateness of many waste treatments to debris; Difficulties in obtaining representative samples; Costs associated with applying waste specific treatments to debris; Subtitle C landfill space was being used for many low hazard debris types. These factors brought about the need for debris treatment technologies and regulations that addressed these issues. The goal of such regulation was to provide treatment to destroy or remove the contamination if possible and, if this is achieved, to dispose of the cleaned debris as a nonhazardous waste. EPA has accomplished this goal through promulgation of the Hazardous Debris Rule, August 18, 1992.

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Refer also to citation(s) 25820, 26104, 26448, 26467, 26524, 26536

26543 (CRIE-T–91085) **Investigation on load prediction method for domestic customer.** Asari, M.; Yoshimitsu, T.; Hashimoto, E. Central Research Inst. of Electric Power Industry, Komae, Tokyo (Japan). Energy and Environment Lab. Jun 1992. 35p. (In Japanese). Order Number DE93798904. Source: OSTI; NTIS; Available from Central Research Inst. of Electric Power Industry, 1-6-1, Ote-machi, Chiyoda-ku, Tokyo, Japan.

Levelling of power load should be promoted by grasping various patterns of power demand such as domestic use and industrial use power. An operation plan is first made for heat storage equipment/electric batteries installed at general household for load levelling, and a basic logic of the load prediction method indispensable for daily operation is clarified. Each household has its own pattern of operation of each electric appliance. When heat storage equipment/electric batteries are not used, power load which can be shifted to the midnight time zone without giving unpleasantness to users is 3-5%, but cost merits of the time-of-day power rates are very small. The most effective method for short-term (one-hour) prediction is an adaptive time-series model which renews prediction parameters one by one by using gaps between measured values in the past and predicted values. For prediction of next day' load curve, proposed is a neural network adaption model, which is higher in accuracy and flexibility than other models and therefore promising. 21 figs., 4 tabs.

26544 (DOE/FTR–93011812) **Evaluation of the integrated municipal solid waste management systems extant in Japan, with special emphasis on the effectiveness of recycling activities: Foreign trip report, October 10–24, 1992.** Cohen, A.S. (CSI Resource Systems, Inc., Boston, MA (United States)); Abert, J. National Renewable Energy Lab., Golden, CO (United States). 18 Nov 1992. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-83CH10093. Order Number DE93011812. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Meetings were held with national government officials to discuss the legislative and regulatory structure governing municipal solid waste management in Japan. Additional meetings were held with local officials to learn how these policies are actually implemented. Tours of waste-to-energy, materials-recovery, and materials-processing facilities provided added insights into the actual implementation activities. Finally, meetings were held with officials from various associations and consultants to assess the true level and types of recycling occurring in Japan. Reports and data were obtained that will support the findings and conclusions that will be documented in the final report being prepared by CSI on solid waste management practices in Japan.

26545 (ETDE/JP-mf–93798681, pp. 54-59) **Process of dioxin generation and its preventive mechanisms.** Kato, T. (Yokohama National University, Yokohama (Japan)). 20 Jan 1993. 94p. (In Japanese). In *Symposium on global environmental conservation*

and air pollution prevention technology. Order Number DE93798681. Source: OSTI; NTIS (US Sales Only).

Based on the fact that dioxin containing substances is not generated in gaseous phase in incineration furnaces at refuse incineration plants, but in ash in dust collector EP with controllable fashions, this paper describes its generation process and its preventive measures. An incineration furnace makes oxidizing reaction to progress at a temperature as high as 700°C, but causes no chlorinating reaction to occur. In contrast, an electric dust collector operates at 300°C, where chlorinating reaction progresses efficiently to produce dioxin and other organic chlorinated compounds. Among various factors in the system, correlation with temperature is decisively high, with chlorination of unburned organic components rising sharply from 200°C and reaching the maximum level at 300°C. Therefore, a first preventive measure should be to improve dust collectors to be usable at lower temperatures. Secondly, dechlorination of EP ash by means of heating it to higher than 400°C. A third measure should include measurement of chlorobenzenes which correlate with dioxin, to simplify overall measurement systems and establish monitoring systems. 5 figs., 1 tab.

26546 (ETDE/JP-mf–93798681, pp. 60-65) **Technologies to treat refuse incineration exhaust gases.: Trends in NOx, HCl and mercury treating technologies.** Sato, T. (NKK Corp., Tokyo (Japan)). 20 Jan 1993. 94p. (In Japanese). In *Symposium on global environmental conservation and air pollution prevention technology.* Order Number DE93798681. Source: OSTI; NTIS (US Sales Only).

The environment around wastes treatment is changing largely as a result of increase in amount of refuse generated and the strengthened treatment regulations. This paper describes trends in treatment technologies to cope with these changes. The 'Guideline to preventing dioxin (DXN) generation' published in the end of 1990 has created efforts to lower the dust collector inlet temperature below 200°C and to convert conventional electric dust collectors to filtering dust collectors. Attention is drawn on improvements in combustion control for NOx emission, wider use of dry methods for HCl and SOx, and chelate rinsing of harmful gases from mercury. New technologies may include a neutralizing removal process that produces chemically active species in exhaust gases by irradiating electron beams to turn SOx and NOx into sulfuric acid and nitric acid, use of denitrification BF loaded with denitrifying catalytic components, a system spraying activated coal powder into exhaust gases to adsorb mercury and DXN, and a process to arrest mercury using a heat resistant chelating agent. 1 fig., 2 tabs.

26547 (ETSU-B–00337) **Some observations on municipal solid waste management in Japan.** Patel, N.M. (AEA Environment and Energy, Harwell (United Kingdom)); Edgcumbe, D. AEA Environment and Energy, Harwell (United Kingdom). 1992. 36p. Order Number DE93504809. Source: OSTI; NTIS (US Sales Only).

Japan's policy on Municipal Waste Management is dictated, essentially, by an acute lack of landfill capacity and, more recently, by heightened environmental concerns. Having, in the fifties and sixties, embarked on a major programme of incinerator construction, Japan has continued to rely on this technology to underpin the waste management function. Currently about 1900 incinerators operate nationwide treating about 75% of the annual municipal waste arisings. The target for incineration is 80%, so the programme of renewal of existing facilities and construction of new plant continues unabated. The increasing affluence of Japanese society over the last two decades has been reflected in the composition of the waste that is produced; essentially seeing an increase in paper and plastic content and a decrease in putrescible matter. To overcome this a source segregation system was introduced to classify the waste stream into three categories; combustible, non-combustible (to include the problematic plastic component) and bulky items. (author)

26548 (KTM/E-B–144) **Energy balance of waste management.** Ranne, A.; Virtanen, Y.; Maekelae, K. Ministry of Trade and Industry, Helsinki (Finland). Energy Dept. 1993. 84p. (In Finnish). Project KTM-272/881/92. Order Number DE93500408. Source: OSTI; NTIS.

The specific energy content of municipal solid wastes is about 27 MJ/kg, where the energy content is defined as the sum of the energy used in manufacturing of materials and the heat value of materials. The heat value of municipal wastes suitable for incineration is about 13 MJ/kg. The energy content of landfill waste in whole Finland is 74000 TJ annually, which means about 6 per cent of the total energy used in the country. The transport energy in the form of liquid fuels used in the waste management is 0,2 - 0,3 MJ per waste kilogram, when the final treatment is landfilling. There are some possibilities to recover energy included in municipal waste: to collect biogas generated in landfills, to incinerate refuse, and to recycle materials. Biogas could be collected to useful energy is about 4300 TJ annually in the entire country and 850 TJ in the Metropolitan area. These values are about 15 per cent of the heat energy that can be recovered in incineration of refuse. The use of primary energy sources would reduce about 11 000 TJ, if the refuse in Metropolitan area were Incinerated. The recycling of materials offers benefits from the viewpoint of primary energy needed and environmental emissions generated. The current recycling of waste paper of the Metropolitan area reduces the use of primary energy sources 9000 TJ annually as compared to landfilling as the other alterative. The recycling of waste glass from glass packaging used in the Metropolitan area brings about an energy conservation of 20 TJ yearly. Recycling of some other materials ie. aluminium, polyethylene and steelplate, are estimated to be beneficial from the viewpoint of energy economy.

26549 (NEI-DK–1184) **The consequences for water purifying plants of using smooth water in district heating transmission systems.** Energiministeriets Energiforskningsprogram. Fjernvarme og produktion af el og varme. Hammer, F.; Soerensen, M.; Wieck-Hansen, K. Bruun og Soerensen Energiteknik A/S, Aarhus (Denmark); Faelleskemikerne (Denmark). Jan 1993. 84p. (In Danish). Contract ENS-1323/90-0011. Order Number DE93500138. Source: OSTI; NTIS.

EFP-90.

The purpose was to establish the consequences to water purification plants in district heating transmission networks of using a friction- reducing, tenside-based additive. Possible solutions of solving any problems in this respect were to be found. Experiments were carried out with a mechanical filter and an ion exchanger plant. It was found that the efficiency of the filter in the mechanical filtration was reduced. This was due to the changes in the shape, size and surface properties of the iron particles due to the addition of the tenside. These changes would not necessarily lead to problems in the system. The iron particles will probably be circulated with the district heating water, so will not precipitate or cause corrosion. The tenside concentration was not reduced as a result of the filtration and no decomposition of the tenside occurs. It is concluded that ion exchanger resins are unfit for district heating systems using smooth water. Such filters absorb almost all the tenside, and fouling of the resins would occur in the short term. Discharge from the regeneration of the ions exchanger resins is also a problem. But an ion exchanger plant will only be necessary in a district heating plant for the initial three years of operation. After this phase the addition of tenside could take place. Plants using desalinated water conditioned with ammonia where there is no ion exchanger plant at the water/steam side need very careful monitoring for leaks. (AB).

26550 (NEI-DK–1185) **Central heating in older housing blocks.** Energiministeriets Energiforskningsprogram. Fjernvarme og produktion af el og varme. Koebenhavns Belysningsvaesen, Copenhagen (Denmark); Roerbyg Koebenhavn A/S (Denmark); Ramboell, Hannemann og Hoejlund A/S, Copenhagen (Denmark). Feb 1993. [106p.] (In Danish). Contract ENS-151/90-0035. Order Number DE93500143. Source: OSTI; NTIS.

EFP-90.

A survey was made of the sizes of the flats in Copenhagen, Denmark which were expected to be retrofitted with supply of heat from a cogeneration plant. The design principles for two types of heating system comprising a two string connection and indirect connection are described. A number of proposals for types of system, including pipe layout, which could be used are explained and relevant prices are given. Most of the flats are fairly small, and here a traditional system with a common boiler in the cellar would be the cheapest and most flexible, it was found. In the case of smaller numbers of larger flats where individual control of heating is wished

for, a decentral system was found to be more appropriate. Here there can be more flexibility in relation to times of payment. (AB)

26551 (NEI-DK–1190) **Study on identification of guideline projects for the sustainable development of the district heating sector. Bulgaria. Vol 1: Final report.** Danish Energy Group, Silkeborg (Denmark); Bruun og Soerensen Energiteknik A/S, Aarhus (Denmark); Birch og Krogboe A/S, Virum (Denmark). Feb 1993. 150p. Contract IMOe-584. Order Number DE93500118. Source: OSTI; NTIS.

The Bulgarian district heating system was developed under a planned economy, that is now gradually changing to a market economy, at the same time as Bulgaria is in a serious energy crisis. The project's purpose therefore, is to identify projects in the Bulgarian district heating sector for the World Bank, the European Investment Bank, and the European Bank for Reconstruction and Development, that can minimise energy consumption and reduce environmental problems within the Bulgarian district heating sector. The report is divided into two volumes. The first includes "State-of-the-art" for the entire energy production, distribution, consumption and energy prices as well as eighteen project proposals including amongst other - (a) identification of defects in the district heating network, (b) improvement of maintenance organisations, (c) metering and regulating projects, (d) district heating legislation under market conditions and (e) utilisation of geothermal resources in the district heating sector. The second volume includes all relevant data and statistical information within the district heating sector in Bulgaria divided into regions, and cities, respectively over and under 50,000 inhabitants. The project is carried out in close cooperation with the Bulgarian authorities and district heating associations. (au).

26552 (NEI-DK–1191) **Study on identification of guideline projects for the sustainable development of the district heating sector. Bulgaria. Vol. 2: Final report.** Danish Energy Group, Silkeborg (Denmark); Bruun og Soerensen Energiteknik A/S, Aarhus (Denmark); Birch og Krogboe A/S, Virum (Denmark). Feb 1993. 202p. Contract IMOe-584. Order Number DE93500102. Source: OSTI; NTIS.

The Bulgarian district heating system was developed under a planned economy, that is now gradually changing to a market economy, at the same time as Bulgaria is in a serious energy crisis. The project's purpose therefore, is to identify projects in the Bulgarian district heating sector for the World Bank, the European Investment Bank, and the European Bank for Reconstruction and Development, that can minimise energy consumption and reduce environmental problems within the Bulgarian district heating sector. The report is divided into two volumes. The first includes "State-of-the-art" for the entire energy production, distribution, consumption and energy prices as well as eighteen project proposals including amongst others - (a) identification of defects in the district heating network, (b) improvement of maintenance organisations, (c) metering and regulating projects, (d) district heating legislation under market conditions and (e) utilisation of geothermal resources in the district heating sector. The second volume includes all relevant data and statistical information within the district heating sector in Bulgaria divided into regions, and cities, respectively over and under 50,000 inhabitants. The project is carried out in close cooperation with the Bulgarian authorities and district heating associations.

26553 (NEI-DK–1196) **District heating master plan study and assessment. Debrecen and Szazhalombatta: Executive summary.** Danish Energy Consultants, Glostrup (Denmark). May 1993. 12p. Contract ENS-2124/93-0001. Order Number DE93500109. Source: OSTI; NTIS.

The report summarizes the findings and conclusions of a technical assessment and evaluation of the existing district heating systems in Szazhalombatta and Debrecen, Hungary, based on the evaluation of information and data given at meetings with the Hungarian electricity board and other relevant authorities. The main issues were to prepare estimates of the future heat demand and to calculate the economic consequences of improvements of the district heating systems. It was recommended to invest in cogeneration units. Economical and environmental aspects were taken into consideration. It is suggested that it would be advisable to undertake, at an energy policy level, an increase in prices of energy over a span of years to the world market level and to establish a tariff and payment system that encourages energy savings. The recommendations in the case of each town are discussed given in detail. (AB).

26554 (ORNL/CON–364) **Electric-utility DSM-program costs and effects, 1991 to 2001.** Hirst, E. Oak Ridge National Lab., TN (United States). May 1993. 33p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93016238. Source: OSTI; NTIS; GPO Dep.

For the past three years (1989, 1990, and 1991), all US electric utilities that sell more than 120 GWh/year have been required to report to the Energy Information Administration data on their demand-side management (DSM) programs. These data provide a rich and uniquely comprehensive picture of electric-utility DSM programs in the United States. Altogether, 890 utilities (of about 3250 in the United States) ran DSM programs in 1991; of these, 439 sold more than 120 GWh and reported details on their DSM programs. These 439 utilities represent more than 80% of total US electricity sales and revenues. Altogether, these utilities spent almost $1.8 billion on DSM programs in 1991, equal to 1.0% of total utility revenues that year. In return for these (and prior-year) expenditures, utility DSM programs cut potential peak demand by 26,700 MW (4.8% of the national total) and cut annual electricity use by 23,300 GWh (0.9% of the national total). These 1991 numbers represent substantial increases over the 1989 and 1990 numbers on utility DSM programs. Specifically, utility DSM expenditures doubled, energy savings increased by almost 50%, and demand reductions increased by one-third between 1989 and 1991. Utilities differed enormously in their DSM-program expenditures and effects. Almost 12% of the reporting utilities spent more than 2% of total revenues on DSM programs in 1991, while almost 60% spent less than 0.5% of revenues on DSM. Utility estimates of future DSM-program expenditures and benefits show continuing growth. By the year 2001, US utilities expect to spend 1.2% of revenues on DSM and to cut demand by 8.8% and annual sales by 2.7%. Here, too, expectations vary by region. Utilities in the West and Northwest plan to spend more than 2% of revenues on DSM that year, while utilities in the Mid-Atlantic, Midwest, Southwest, Central, and North Central regions plan to spend less than 1% of revenues on DSM.

26555 (SAND–92-2903C) **Neural network hardware and software solutions for sorting of waste plastics for recycling.** Stanton, S.L.; Alam, M.K.; Hebner, G.A. Sandia National Labs., Albuquerque, NM (United States). [1992]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9305187–1: Ideas in science and electronics, Albuquerque, NM (United States), 11 May 1993). Order Number DE93012850. Source: OSTI; NTIS; GPO Dep.

While plastic recycling efforts have expanded during the past several years, the cost of recovering plastics is still a major impediment for recyclers. Several factors contribute to the prohibitive cost of recycled resins, including the present low marketability of products made with mixed recycled materials, and costs of collecting, sorting and reprocessing plastic materials. A method for automatic sorting of post-consumer plastics into pure polymer streams is needed to overcome the inaccuracies and low product throughput of the currently used method of hand sorting of waste plastics for recycling. The Society of Plastics has designated seven categories as recyclable: Polyethylene terephthalate (PET); High Density Polyethylene (HDPE); Polyvinyl Chloride (PVC); Low Density Polyethylene (LDPE); Polypropylene (PP); Polystyrene (PS); and Other (mixtures, layered items, etc.). With these categories in mind, a system for sorting of waste plastics using near-infrared reflectance spectra and a backpropagation neural network classifier has been developed. A solution has been demonstrated in the laboratory using a high resolution, and relatively slow instrument. A faster instrument is being developed at this time. Neural network hardware options have been evaluated for use in a real-time industrial system. In the lab, a Fourier transform Near Infrared (FT-NIR) scanning spectrometer was used to gather reflectance data from various locations on samples of actual waste plastics. Neural networks were trained off-line with this data using the NeuralWorks Professional II Plus software package on a SparcStation 2. One of the successfully trained networks was used to compare the neural

accelerator hardware options available. The results of running this "worst case" network on the neural network hardware will be presented. The AT&T ANNA chip and the Intel 80170NX chip development system were used to determine the ease of implementation and accuracies for this network.

26556 (UCRL-JC–109347) **Electrical energy metering use at a large research facility.** Falke, S.S. Lawrence Livermore National Lab., CA (United States). Jan 1992. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9203258–1: National Electrical Testing Association meeting, Charleston, SC (United States), 19 Mar 1992). Order Number DE93013046. Source: OSTI; NTIS; GPO Dep.

A brief history of electric energy metering at a large research laboratory is presented. Limited orientation on metering of power and energy quantities derived from single dimension magnitudes is introduced. Operation and application of electromechanical watthour demand, solid state single function transducers, analog multifunction, and digital multifunction discussed. Applications for interdepartmental revenue transfer based on energy and power flow, load profiling, system planning, and use as a troubleshooting tool are described. The material is presented in a perspective for persons familiar with protective relaying components, but lacking similar experience in energy metering.

3209 Education and Public Relations

Refer also to citation(s) 26451, 26475, 26523

26557 (ETDE-IT–93-191) **Data analysis, diagnostics, monitoring and control systems to support plant efficiency and rational use of energy in industrial plant.** Di Bartolomeo, M.; Federico, A.G. ENEA, Casaccia (Italy). Area Energetica. 1992. 14p. (CONF-9210372–3: Workshop on the rational use of energy, Budapest (Hungary), 27-29 Oct 1992). Order Number DE93799201. Source: OSTI; NTIS (US Sales Only).

The paper is a departmental review of the methods and the technologies adopted by the Energy Plants Dpt. of ENEA (Italian Committee for the New Technologies, Energy and Environment), a research group of 180 technicians devoted to the study, analysis and transfer to industry and end users of that part of technological innovation that plays a role in the optimization of the production processes, mainly with reference to energy saving and process optimization. The original orientation of the unit, towards the improvement of the efficiency, control and intrinsic safety of nuclear and conventional energy production moratorium plants, was deeply changed after the Italian nuclear program towards energy saving and quality control in industrial processes. New methods were requested and new criteria of technology diffusion were developed for the new goals. This paper accounts for some significant projects involving: applications in the energy plants area; innovations introduced in some reference production sectors such as metal and materials production, components manufacturing, textiles, etc.; the role of the product quality control, design and production methods validation and of components certification; applications in the transportation area, with special reference to the energy environmental control of urban traffic; the role of the automation technologies in the diffusion of the energy saving; the role of the early diagnosis and non-destructive testing in process management.

33 ADVANCED PROPULSION SYSTEMS

3301 Internal Combustion Engines

26558 (DTH-LET-RE–93-4) **The use of straw-derived gas as fuel in gas motors.** Kofoed, E.; Christensen, O.; Henriksen, U. Danmarks Tekniske Hoejskole, Lyngby (Denmark). Lab. for Energiteknik. [1993]. 18p. (In Danish). Order Number DE93500188. Source: OSTI; NTIS.

When gas derived from straw is used as fuel in gas engines, back-firing occurs under some operational conditions. Based on a survey of literature on the use of hydrogen as fuel in internal combustion engines, where this phenomenon is shown to be well-known, the conclusion is drawn that the hydrogen content of the straw-derived gas is a significant cause of the back-firing. Another cause could be the presence of carbon particles in the combustion chamber. Several methods that work against these negative conditions are briefly described. (AB) (34 refs.).

3303 Electric-Powered Systems

26559 (ANL/MCT/CP–78162) **Controls of maglev suspension systems.** Cai, Y.; Zhu, S.; Chen, S.S.; Rote, D.M. Argonne National Lab., IL (United States). [1993]. 43p. Sponsored by Department of Defense, Washington, DC (United States); Department of Transportation, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-930702–41: Pressure vessels and piping conference, Denver, CO (United States), 25-29 Jul 1993). Order Number DE93015540. Source: OSTI; NTIS; GPO Dep.

This study investigates alternative control designs of maglev vehicle suspension systems. Active and semi-active control law designs are introduced into primary and secondary suspensions of maglev vehicles. A one-dimensional vehicle with two degrees of freedom, to simulate the German Transrapid Maglev System, is used for suspension control designs. The transient and frequency responses of suspension systems and PSDs of vehicle accelerations are calculated to evaluate different control designs. The results show that active and semi-active control designs indeed improve the response of vehicle and provide an acceptable ride comfort for maglev systems.

26560 (DOE/CE–0395) **Utility emissions associated with electric and hybrid vehicle (EHV) charging.** USDOE Assistant Secretary for Energy Efficiency and Renewable Energy, Washington, DC (United States). Electric and Hybrid Propulsion Div. Apr 1993. 128p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93013734. Source: OSTI; NTIS; INIS; GPO Dep.

This project is a joint effort between the US Department of Energy (DOE) and the Electric Power Research Institute (EPRI) to conduct a comprehensive, in-depth assessment of the emission impacts of electric and hybrid vehicles (EHVs). The study determines local and regional emission impacts under a variety of scenarios, covering both conservative and optimistic assumptions about vehicle efficiency, power plant efficiency, and other factors. In all scenarios, EHV use significantly reduces urban emissions of CO, VOC, and TSP. Changes in NO_x and CO_2 emissions are very sensitive to average or marginal power plant emissions and vehicle efficiency assumptions. NO_x and CO_2 emissions changes vary dramatically by region. Certain combinations of EHV and CV scenarios and regions result in significant reductions, while other combinations result in significant increases. Careful use of these results is advised. In all scenarios, SO_2 increases with EHV use although the amount is small-less than 1% of total utility emissions even vath the deployment of 12 million EHVS. But because of emission cap provisions of the Clean Air Act Amendments of 1990, national SO_2 totals will not be allowed to increase. Thus, utilities will have to apply more stringent measures to combat increased SO_2 emissions due to the increased use of electric vehicles.

26561 (ETDE/JP-mf–93798909) **Prospect on new energies.: Electric vehicles.** Institute of Applied Energy, Tokyo (Japan). Mar 1992. 31p. (In Japanese). Order Number DE93798909. Source: OSTI; NTIS; Available from The Institute of Applied Energy, 14-2, Nishishinbashi 1-chome, Minato-ku, Tokyo, Japan.

This paper reports surveys on electric vehicles carried out by the General Energy Engineering Research Institute of Japan. Electric vehicles have not evolved because of having been incapable of sufficient performance to be competitive with gasoline fueled cars. Global environmental problems having become conspicuous, attentions have been drawn again to electric vehicles. The present flash point is in the central Los Angeles area in Southern California with very heavy air pollution, where automobile makers and distributors in that state were obligated to sell electric vehicles at a certain rate after 1998. Electric vehicles with the currently available performance have no chance of success. The vehicles have a number of

problems including development of batteries, and their future is uncertain. Further promotion of their use requires strongly social consensus, assistance for technical development, and economic subsidiary measures. It may safely be said that practicable electric vehicles are the most influential theme for solving drastically the problem of automotive exhaust emission. Nothing can, however, guarantee that the Californian requirement would be complied with as being called for. Works on a long-term basis is desirable. 12 refs., 6 figs., 7 tabs.

3304 Hybrid Systems

Refer also to citation(s) 26560

3307 Emission Control

26562 (UCRL-JC–112689-Rev.1) **Application of non-thermal plasmas to pollution control: Revision 1.** Penetrante, B.M.; Vogtlin, G.E.; Bardsley, J.N.; Vitello, P.A.; Wallman, P.H. Lawrence Livermore National Lab., CA (United States). Jun 1993. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-930256–1-Rev.1: 2. international plasma symposium on world progress in plasma applications, Palo Alto, CA (United States), 9-11 Feb 1993). Order Number DE93016432. Source: OSTI; NTIS; INIS; GPO Dep.

Non-thermal plasma techniques can be used to destroy many types of hazardous molecules. They are particularly efficient when the toxic materials are present in very small concentrations. This paper discusses three particular applications of non-thermal plasmas: (1) decomposition of hydrogen sulfide (H_2S), (2) removal of trichloroethylene (TCE), and (3) removal of nitrogen oxides (NO_x). Emphasis is placed on the energy cost for implementing the decomposition or removal of these pollutants. Some of the factors affecting the energy cost are discussed. The authors discuss in detail their work at LLNL on pulsed plasma processing for the treatment of NO_x in diesel engine exhaust. The results suggest that their plasma reactor can remove up to 70% of NO with relatively high initial concentrations (up to 500 ppM) at a power consumption cost of 2.5% for an engine with an output of 14 kW and an exhaust gas flow rate of 1,200 liters per minute.

35 ARMS CONTROL

Refer also to citation(s) 27265

26563 (INIS-mf–12758, pp. 634-638) **Nuclear reactors and disarmament.** Almagro, J.C. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina). Gerencia de Procesos Quimicos); Estrada Oyuela, M.E.; Garcia Moritan, R. Asociacion Argentina de Tecnologia Nuclear, Buenos Aires (Argentina). 1987. [735p.] (In Spanish). (CONF-8711355–: 15. scientific meeting and 4th Latin American meeting and 1st sessions on nuclear power plants, San Carlos de Bariloche (Argentina), 2-6 Nov 1987). In *Proceedings of the fifteenth scientific meeting; fourth Latin American meeting; first sessions on nuclear power plants.* Order Number DE91003052. Source: OSTI; NTIS (US Sales Only); INIS.

From a brief analysis of the perspectives of nuclear weapons arsenals reduction, a rational use of the energetic potential of the ogives and the authentic destruction of its warlike power is proposed. The fissionable material conversion contained in the nuclear fuel ogives for peaceful uses should be part of the disarmament agreements. This paper pretends to give an approximate idea on the resources re assignation implicancies. (Author).

3501 Policy, Negotiations, and Legislation

26564 (SAIC–93015937) **The economics of proliferation and counterproliferation: Final report.** Murray, B.L.; Hallenbeck, R.A.; Gill, J.M. Science Applications International Corp., McLean, VA (United States). 17 Jun 1993. 51p. Sponsored by USDOE, Washington, DC (United States); Department of Defense, Washington, DC (United States); Arms Control and Disarmament Agency, Washington, DC (United States). (CONF-9306192–Exec.Summ.: Seminar on economics of proliferation and counterproliferation, McLean, VA (United States), 2 Jun 1993). Order Number DE93015937. Source: OSTI; NTIS; INIS; GPO Dep.

On June 2, 1993, the fourth meeting of the seminar series on "Proliferation of Ballistic Missiles and Weapons of Mass Destruction and Implications for Regional Stability" was held at SAIC in McLean, Virginia. This series is sponsored by the Arms Control and Disarmament Agency and is cosponsored by the Ballistic Missile Defense Organization, the Defense Nuclear Agency, the Department of Energy, and the Office of the Secretary of Defense for International Security Policy. The June seminar, "The Economics of Proliferation and Counterproliferation," discussed how economic issues and interests affect proliferation judgments. Seminar participants also examined three economic tools for advancing counterproliferation objectives: Economic Development Assistance, Export Controls, and Economic "Burdensharing" and Conversion Assistance.

3502 Proliferation

Refer also to citation(s) 25895, 26564, 27263

26565 (UCRL-JC–113281) **Managing nuclear weapons in the United States.** Miller, G. Lawrence Livermore National Lab., CA (United States). 16 Mar 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9211112–1: Conference on managing nuclear weapons in a changing world, Livermore, CA (United States), 17-18 Nov 1992). Order Number DE93017171. Source: OSTI; NTIS; GPO Dep.

This report discusses the management and security of nuclear weapons in the post-cold war United States. The definition of what constitutes security is clearly changing in the US. It is now a much more integrated view that includes defense and the economy. The author tries to bring some semblance of order to these themes in this brief adaptation of a presentation.

26566 (WINCO–11907) **Noble gas, a potential nuclear proliferation indicator.** Chapman, T.C. Westinghouse Idaho Nuclear Co., Inc., Idaho Falls, ID (United States). [1993]. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-84ID12435. (CONF-930601–21: American Nuclear Society (ANS) annual meeting, San Diego, CA (United States), 20-24 Jun 1993). Order Number DE93014908. Source: OSTI; NTIS; GPO Dep.

In the post cold war era, it appears that nuclear proliferation will be a continuing problem. At least one reliable technique to detect nuclear activities is needed to deter potential proliferators. This paper proposes a candidate technique for detection. Early efforts to measure nuclear fuel performance, resulted in consideration of a variety of potential techniques. In 1965, Maeck proposed determination of nuclear fuel burnup based on the ratio of two stable fission product isotopes of the same element. Maeck proposed using three ratios; $^{84}Kr/^{83}Kr$, $^{132}Xe/^{131}Xe$, and $^{144}Nd/^{143}Nd$. More recent work includes useful application of krypton and xenon isotope correlation techniques to safeguards at nuclear fuel reprocessing facilities. The safeguards application requires very precise measurement of the fission product isotopes, detailed fuel exposure history, and knowledge of the neutron spectrum. Meeting all these requirements is extremely, difficult and requires carefully controlled conditions. The most likely scenario for a proliferator to produce nuclear material suitable for weapons applications is reprocessing of reactor fuel to recovery the plutonium. Since useful amounts of plutonium is produced in all uranium fueled reactors, reprocessing the reactor fuel would be much easier and less expensive compared to mining and enriching uranium to weapons grade material. Reprocessing nuclear reactor fuel releases the noble gases, krypton and xenon, from the fuel. Because capture of the noble gases is difficult, expensive, and produces a radiation, the gases will normally be released during reprocessing. These factors provide the basis of this proposed technique of detecting proliferators.

3503 Verification

Refer also to citation(s) 26893, 27200, 27258, 27259, 27261, 28094

26567 (WINCO–1121) **Technical specifications manual for the MARK-1 pulsed ionizing radiation detection system: Volume 1.** Lawrence, R.S.; Harker, Y.D.; Jones, J.L.; Hoggan, J.M. Westinghouse Idaho Nuclear Co., Inc., Idaho Falls, ID (United States). Mar 1993. 214p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-84ID12435. Order Number DE93014825. Source: OSTI; NTIS; INIS; GPO Dep.

The MARK-1 detection system was developed by the Idaho National Engineering Laboratory for the US Department of Energy Office of Arms Control and Nonproliferation. The completely portable system was designed for the detection and analysis of intense photon emissions from pulsed ionizing radiation sources. This manual presents the technical design specifications for the MARK-1 detection system and was written primarily to assist the support or service technician in the service, calibration, and repair of the system. The manual presents the general detection system theory, the MARK-1 component design specifications, the acquisition and control software, the data processing sequence, and the system calibration procedure. A second manual entitled: Volume 2: Operations Manual for the MARK-1 Pulsed Ionizing Radiation Detection System (USDOE Report WINCO-1108, September 1992) provides a general operational description of the MARK-1 detection system. The Operations Manual was written primarily to assist the field operator in system operations and analysis of the data.

36 MATERIALS

Refer also to citation(s) 26177, 26829, 26830, 26907, 27927

26568 (LBL–31572) **A coarsening model for coherent precipitates.** McCormack, M.T. Lawrence Berkeley Lab., CA (United States). Dec 1991. 67p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. Order Number DE93015182. Source: OSTI; NTIS; GPO Dep.

The morphological evolution of coherent inclusions in elastic media is studied in two-dimensions. The inclusions are simple dilations with isotropic surface energy in a system with homogeneous elastic constants of negative anisotropy. The equilibrium sizes at which a circular inclusion transforms to a rectangle or square, and at which a square splits into a doublet or quartet of separated inclusions are computed analytically. A finite-element model is then constructed to simulate the evolution of an arbitrary distribution of inclusions along the minimum-energy path. In the model, the circle evolves into a square, which splits into a doublet by hollowing from its center, or, if this is forbidden, by drawing in a perturbation on its surface. The sizes at which shapes spontaneously transform are compared to the equilibrium values. Finally, the simulation is used to study the evolution of a random distribution of inclusions. The first metastable state assumed by the distribution depends on the elastic interaction, surface energy and areal fraction of the inclusion phase through a single dimensionless parameter that groups these three effects. Results are compared to prior theoretical and experimental work on coarsening patterns in three dimensions.

3601 Metals and Alloys

Refer also to citation(s) 25487, 25608, 25642, 25674, 25835, 25843, 26167, 26229, 26237, 26240, 26276, 26335, 26735, 26767, 26851, 26883, 26911, 26932, 26942, 26945, 26947, 26952, 27048, 27721, 27894, 27911, 27912, 27933, 28038, 28039, 28044, 28046, 28047, 28048

26569 (ANL/XFD/CP–79634) **Interfacial structure of lattice mismatched bcc(110)/bcc(110) transition metal superlattices.** Fullerton, E.E. (Argonne National Lab., IL (United States)); Sowers, C.H.; Bader, S.D.; Mini, S.; Bommannavar, A.S.; Ehrlich, S.N. Argonne National Lab., IL (United States). Mar 1993. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-930405–18: Spring meeting of the Materials Research Society, San Francisco, CA (United States), 12-16 Apr 1993). Order Number DE93015162. Source: OSTI; NTIS; GPO Dep.

We present structural characterizations of a series of sputtered Fe/Nb and V/Nb superlattices by high-angle x-ray diffraction. Diffraction scans were performed with the scattering vector at various angles (X) with respect to the layers. X=0° diffraction spectra (normal to the layers) were fitted to a general structural model to determine the (110) lattice strains, interfacial disorder and interdiffusion. X>0° spectra probe the lattice strain of the individual layers and the in-plane interfacial coherence. Both systems form incoherent interfaces above a critical modulation wavelength (Λ_C). At Λ_C, the Fe/Nb system undergoes a crystalline-to-amorphous transition while the V/Nb forms in-plane coherent interfaces.

26570 (BNL–48655) **Passive oxide films on well-defined nickel surfaces: An examination of film growth on Ni(100) with ex situ scanning tunneling microscopy.** Vitus, C.M.; Davenport, A.J. Brookhaven National Lab., Upton, NY (United States). [1993]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-9309150–2: 12. international corrosion congress, Houston, TX (United States), 19-24 Sep 1993). Order Number DE93014056. Source: OSTI; NTIS; GPO Dep.

The surface morphology and atomic structure of air-formed and passive oxide films on a Ni(100) single crystal is presented. The passive oxide film was formed in a 0.15N Na_2SO_4 solution (pH = 2.8) anodized at 0.0 V vs. Hg/Hg_2SO_4 reference.

26571 (BNL–48665) **In situ studies of passive film chemistry using x-ray absorption spectroscopy.** Davenport, A.J. (Brookhaven National Lab., Upton, NY (United States)); Isaacs, H.S.; Bardwell, J.A.; MacDougall, B. Brookhaven National Lab., Upton, NY (United States). [1993]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-9309150–1: 12. international corrosion congress, Houston, TX (United States), 19-24 Sep 1993). Order Number DE93014023. Source: OSTI; NTIS; GPO Dep.

The passive film on sputter-deposited thin film Fe and Fe-26Cr electrodes has been examined using in situ X-ray Absorption Near Edge Spectroscopy (XANES). During the x-ray spectroscopic measurements, samples were maintained under potentiostatic control in pH 8.4 borate buffer. The passive film on both Fe and Fe-26Cr is formed from the metal without any detectable losses due to dissolution. Cathodic reduction leads to a loss of Fe from the film in both cases, but substantially less Fe is lost in the case of Fe-26Cr. Transpassive dissolution of Cr from Fe-26Cr only occurred on the second potential cycle after the film had been enriched in Cr due to the reductive dissolution of Fe. Simultaneous collection of both the Fe and Cr x-ray absorption edges provides quantitative information on the relative amounts of material lost during passivation and reduction.

26572 (BNL–48706) **Application of in situ scanning x-ray fluorescence to study the concentration of metal ions in simulated pits.** Isaacs, H.S. (Brookhaven National Lab., Upton, NY (United States)); Davenport, A.J.; Jeong-Hwan, Cho; Rivers, M.L.; Sutton, S.R. Brookhaven National Lab., Upton, NY (United States). [1993]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-9309150–3: 12. international corrosion congress, Houston, TX (United States), 19-24 Sep 1993). Order Number DE93014054. Source: OSTI; NTIS; GPO Dep.

X-ray energy-dispersive spectroscopy has been used to study the compositions of metal ions in solutions developed during localized corrosion. An electrochemical cell was designed to simulate a corrosion pit, maintaining one-dimensional diffusion and fulfilling the requirements for x-ray fluorescence measurements. The working electrode consisted of a dissolving thin foil of Type 304 stainless steel sealed between Mylar sheets through which the x-ray beam passed. Concentration gradients within the artifical pit were quantitatively determined.

26573 (BNL–48707) **Potential transients, transmission and electrochemical corrosion detection.** Isaacs, H.S. (Brookhaven National Lab., Upton, NY (United States)); Cho, Jeong-Hwan. Brookhaven National Lab., Upton, NY (United States). [1993]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-9309150–4: 12. international corrosion congress, Houston, TX (United States), 19-24 Sep 1993). Order Number DE93014055. Source: OSTI; NTIS; GPO Dep.

The transmission of potential along a passive metal/electrolyte interface is important in open circuit corrosion monitoring when the containment system rather than an insulated metal specimen is monitored. Potential variations have been considered for transitory and sustained corrosion processes. The observed signals are modified and delayed by the passive surface. Using a transmission line as the equivalent circuit of a pipe and incorporating the impedance characteristics of the passive-metal/solution interface, enabled a quantitative analysis of the effectiveness of corrosion monitoring methods to be carried out.

26574 (BNL–48953) **Spin polarized photoemission studies of interfacial and thin film magnetism.** Johnson, P.D.; Brookes, N.B.; Chang, Y.; Garrison, K. Brookhaven National Lab., Upton, NY (United States). [1993]. 10p. Sponsored by USDOE, Washington, DC (United States); National Science Foundation, Washington, DC (United States). DOE Contract AC02-76CH00016. Contract DMR-86-03304. (CONF-930405–13: Spring meeting of the Materials Research Society, San Francisco, CA (United States), 12-16 Apr 1993). Order Number DE93014326. Source: OSTI; NTIS; GPO Dep.

Spin polarized photoemission is used to study the electronic structure of noble metals deposited on ferromagnetic substrates. Studies of Ag deposited on an Fe(001) substrate reveal a series of minority spin interface or quantum well states with binding energies dependent on the thickness of the silver. Similar behavior is observed for Cu films deposited on a fct Co(001) substrate. Tight-binding modeling reproduces many of the observations and shows that hybridization of the sp-bands with the noble metal d-bands cannot be ignored.

26575 (BNL–48954) **Canted magnetic moments at the Gd(0001) surface.** Li Donggi (Syracuse Univ., NY (US). Dept. of Physics); Zhang Jiandi; Dowben, P.A.; Garrison, K.; Johnson, P.D.; Tang, H.; Walker, T.G.; Hopster, H.; Scott, J.C.; Weller, D.; Pappas, D.P. Brookhaven National Lab., Upton, NY (United States). [1993]. 6p. Sponsored by USDOE, Washington, DC (United States); National Science Foundation, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-930405–14: Spring meeting of the Materials Research Society, San Francisco, CA (United States), 12-16 Apr 1993). Order Number DE93014327. Source: OSTI; NTIS; INIS; GPO Dep.

With spin polarized electron spectroscopies, the authors have investigated ordered Gd(0001) films deposited on W(110). The photoemission features of the gadolinium 5d surface state, the 4f levels, and the background exhibit considerable spin polarization along the same direction in the plane of the film, indicative of ferromagnetic coupling between the surface and the bulk. The 4f spin polarized photoemission data provides strong evidence that the surface 4f polarization differs from the bulk 4f polarization for Gd(0001). The temperature dependent measurements with spin polarized secondary electron spectroscopy conclusively establishes that the surface of clean Gd(0001) possesses a perpendicular polarization component which persists to an enhanced surface Curie temperature. Small amounts of contamination at the surface result in the disappearance of the perpendicular component and, therefore, a more perfect ferromagnetic coupling between the surface and the bulk.

26576 (CEA-CONF–11290) **Chemical and electrochemical aspects of the corrosion of stainless steels in the presence of sulphate reducing bacteria.** Feron, D. (CEA Centre de La Hague, 50 - Cherbourg (France)). CEA Centre d'Etudes de Fontenay-aux-Roses, 92 (France). Service de la Corrosion, d'Electrochimie et Chimie des Fluides. 1990. [10p.] (CONF-9010138–: International congress on microbially influenced corrosion, Knoxville, TN (United States), 7-12 Oct 1990). Order Number DE93630437. Source: OSTI; NTIS (US Sales Only); INIS.

The corrosion behaviour of austenitic and ferritic stainless steels (316 L and 430Ti) in the presence of sulfate reducing bacteria, was investigated by several electrochemical techniques which were coupled with corrosion measurements on coupons and chemical analyses. Experiments were performed with 'Desulfovibrio vulgaris' and 'Desulfovibrio gigas' in three growth media containing lactate and sulfate. The decreases in corrosion potentials were correlated to the increase in sulphide content. The polarization curves showed also the major influence of sulphides on the passivity of stainless steels. Electrochemical impedance measurements were used to provide information in understanding the interactions between growth media or bacteria and stainless steels surfaces. The behaviour of the tested stainless steels in these conditions was mainly dependent on sulphide concentrations. (Author). 7 refs., 8 figs., 4 tabs.

26577 (CEA-CONF–11291) **Morphological kinetics and localized corrosion.** Santarini, G. CEA Centre d'Etudes de Fontenay-aux-Roses, 92 (France). Service de la Corrosion, d'Electrochimie et Chimie des Fluides. 1992. [14p.] (CONF-9210369–: International Conference on Corrosion, deformation interactions, Fontainebleau (France), 5-7 Oct 1992). Order Number DE93630438. Source: OSTI; NTIS (US Sales Only); INIS.

A phenomenological modeling is proposed for physicochemical systems that evolve by initiation and growth of well distinct defects. It consists in a mathematical treatment of data on the evolution of defect distribution, which leads to the knowledge of evolution parameters ultimately usable for behaviour predictions. A method is given for calculating a validity parameter which quantifies the pertinence of the choice for analytical representations. An example of application to localized corrosion is given with the intergranular stress corrosion cracking of Alloy 600 in high temperature water. (Author). 6 refs.

26578 (CEA-CONF–11292) **Application of electrochemical impedance spectroscopy to monitor seawater fouling on stainless steels and copper alloys.** Feron, D. (CEA Centre de La Hague, 50 - Cherbourg (France)). CEA Centre d'Etudes de Fontenay-aux-Roses, 92 (France). Service de la Corrosion, d'Electrochimie et Chimie des Fluides. 1991. [6p.] (CONF-9109491–: International Symposium on Marine and Microbial Corrosion, Stockholm (Sweden), 30 Sep - 2 oct 1991). Order Number DE93630439. Source: OSTI; NTIS (US Sales Only); INIS.

Electrochemical impedance spectroscopy may be applied to detect and to follow seawater fouling. Experiments have been conducted with natural seawater flowing inside tube-electrodes at temperatures between 30 deg C and 85 deg C. With stainless steel tubes, mineral and organic foulings have been followed; a linear relationship between the dry weight of the organic fouling and its electrical resistance, has been observed. On copper alloy tubes, only mineral deposits have occurred and so have been detected by impedance spectroscopy. (Author). 5 refs., 6 figs.

26579 (CEA-CONF–11300) **Compatibility of austenitic and martensitic steels behaviour in semi-stagnant Pb17Li.** Sannier, J.; Dufrenoy, T.; Flament, T.; Terlain, A. CEA Centre d'Etudes de Fontenay-aux-Roses, 92 (France). Service de la Corrosion, d'Electrochimie et Chimie des Fluides. 1991. [12p.] (CONF-911111–: 5. international conference on fusion reactor materials (ICFRM-5), Clearwater, FL (United States), 17-22 Nov 1991). Order Number DE93630440. Source: OSTI; NTIS (US Sales Only); INIS.

Compatibility tests between Pb17Li and 316L austenitic or 1.4914 martensitic steels have been performed with experimental conditions simulating the special features of the water-cooled lithium-lead blanket (low Pb17Li velocity, significant radial thermal gradient and short distances between hot and cold zones). In the 420-475 deg C temperature range, the results show that corrosion kinetics for both 316L and 1.4914 steels are quasi-linear and about 3 times lower compared to turbulent condition. From amount of recovered deposits, the mass transfer of 316L steel at 450 deg C appears to be equivalent to that of 1.1914 steel at 475 deg C. The same relationship was observed in flowing Pb17Li condition.

26580 (CEA-CONF–11301) **Mass transfer of 316L steel in Pb17Li clipper loop after 12000-hour running.** Terlain, A.; Flament, T.; Dufrenoy, T.; Sannier, J. CEA Centre d'Etudes de Fontenay-aux-Roses, 92 (France). Service de la Corrosion, d'Electrochimie et Chimie des Fluides. 1991. [10p.] (CONF-911111–: 5. international conference on fusion reactor materials (ICFRM-5), Clearwater, FL (United States), 17-22 Nov 1991). Order Number DE93630441. Source: OSTI; NTIS (US Sales Only); INIS.

An examination of the large 316L CLIPPER loop has been done after 12000 hour running with Pb17Li, the hot part being at 400 deg C and the cold part at 340 deg C. The morphology and the

chemical composition of the ferritic layer formed on the tubes at 400 deg C are the same as already observed but its thickness is less than expected from previous shorter tests. This feature can be explained by a partial scaling of the layer. Deposits are located in the cold part of the main circuit and in the cold trap. Their mean density in these zones is about 0.4 $mg.cm^{-1}$ and increases where hydraulic perturbations take place. Temperature lowering favours the formation of chromium, nickel and manganese compounds to the detriment of iron.

26581 (CEA-CONF–11302) **Compatibility of stainless steels and lithium based ceramics with beryllium.** Flament, T.; Herpin, D.; Feve, L.; Sannier, J. CEA Centre d'Etudes de Fontenay-aux-Roses, 92 (France). Service de la Corrosion, d'Electrochimie et Chimie des Fluides. 1991. [14p.] (CONF-911111–: 5. international conference on fusion reactor materials (ICFRM-5), Clearwater, FL (United States), 17-22 Nov 1991). Order Number DE93630442. Source: OSTI; NTIS (US Sales Only); INIS.

Introduction of beryllium as neutron multiplier in ceramic blankets of thermonuclear fusion reactors may give rise to the following compatibility problems: - oxidation of beryllium by ceramics or by water vapour, due to the high stability of beryllium oxide, - interaction of beryllium and structural materials. The present report completes previous results and constitutes a synthesis of our work carried out in the compatibility field: - interaction beryllium/steels: a mathematical expression giving the thickness of the diffusion zone as a function of exposure duration and temperature for 316L and 1.1914 steels is proposed, - oxidation of beryllium in contact with Li_2O is noticeable, this phenomenon being much less pronounced with ternary lithium based ceramics, - the oxidation rate of beryllium in the presence of high water vapour content helium is high above 700 deg C.

26582 (CEA-CONF–11303) **Compatibility behavior of beryllium with $LiAlO_2$ and Li_2ZrO_3 ceramics, with 316L and 1.4914 steels in Sibelius.** Flament, T. (CEA Centre d'Etudes de Fontenay-aux-Roses, 92 (France). Service de la Corrosion, d'Electrochimie et Chimie des Fluides); Roux, N.; Abassin, J.J.; Briec, M.; Cruz, D.; Schuster, I. CEA Centre d'Etudes de Fontenay-aux-Roses, 92 (France). Service de la Corrosion, d'Electrochimie et Chimie des Fluides. 1991. [13p.] (CONF-911111–: 5. international conference on fusion reactor materials (ICFRM-5), Clearwater, FL (United States), 17-22 Nov 1991). Order Number DE93630443. Source: OSTI; NTIS (US Sales Only); INIS.

The compatibility under irradiation of beryllium with Li_2O, $LiAlO_2$, Li_4SiO_4 and Li_2ZrO_3 ceramics and with 316L and 1.4914 steels was investigated in SIBELIUS. The irradiation was performed in the SILOE reactor at 550 deg C for 1690 hours in He + 0.1%H_2 purge pas. Examinations of the $LiAlO_2$/Be and Li_2ZrO_3/Be couples show a weak oxidation of beryllium and the presence of cavities near the interface with ceramics. Examinations of the 316L/Be and 1.4914/Be couples show the formation of an oxide layer on all beryllium and steel surfaces suggesting that corrosion arises from a species (most likely T_2O and/or H_2O) present in the environmental atmosphere. Post-irradiation annealing tests of beryllium indicate that the major part of helium is released during irradiation whereas the major part of tritium is released above 700 deg C.

26583 (CEA-CONF–11305) **Determination of the diffusion coefficients of iron and chromium in Pb17Li at 500 deg C.** Simon, N.; Flament, T.; Terlain, A. CEA Centre d'Etudes de Fontenay-aux-Roses, 92 (France). Service de la Corrosion, d'Electrochimie et Chimie des Fluides. 1992. [5p.] (CONF-920930–: 17. symposium on fusion technology, Rome (Italy), 14-18 Sep 1992). Order Number DE93630405. Source: OSTI; NTIS (US Sales Only); INIS.

The diffusion of the dissolved metallic species in a liquid metal towards the boundary layer is one of the elementary steps of the overall mass transfer process induced by thermal gradient. This phenomenon is very probably the limiting step in the mass transfer of martensitic Fe-Cr steels in the presence of Pb17Li liquid eutectic alloy. For estimating diffusion flux, the diffusion coefficients of iron and chromium in Pb17Li are needed but are not known. Consequently these data have been determined in CEA laboratory by measuring metal loss of cylindrical specimens after rotation at 500 deg C in Pb17Li for several hours and applying the first Fick diffusion law in the boundary layer whose the thickness has been previously determined by EISENBERG. After a description of the experimental device, the results are presented and discussed.

26584 (CEA-CONF–11311) **Zirconium behaviour in nitric medium.** Mur, P.; Fauvet, P. CEA Centre d'Etudes de Fontenay-aux-Roses, 92 (France). Service de la Corrosion, d'Electrochimie et Chimie des Fluides. 1990. [5p.] (In French). (CONF-9010356–: Symposium on Zirconium New Material for the Chemical Industry, Lyon (France), 10-11 Oct 1990). Order Number DE93630444. Source: OSTI; NTIS (US Sales Only); INIS.

Zirconium in nitric solutions exhibits an excellent corrosion resistance in the passive state, and a mediocre corrosion resistance in the unpassive state with risk of stress corrosion cracking. Results of the influence of some parameters (medium, potential, temperature, stress, friction, metallurgical structure and surface state) on zirconium passivation are presented. Zirconium remains passive in a large range of HNO_3 concentration (at least up to 14.4N), in the presence of oxidizing ions (Cr^4, Ce^4), in a spent fuel dissolution solution. Zirconium is depassived by friction at high speed and pressure, by platinum coupling in boiling 14.4N HNO_3 with or without stress, or by imposed deformation speed under high potential. (A.B.). 8 figs., 2 tabs.

26585 (CONF-920673–19) **The effect of irradiation on the mechanical properties of 6061-T651 aluminum.** Alexander, D.J. Oak Ridge National Lab., TN (United States). [1992]. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 16. annual symposium of American Society of Testing and Materials (ASTM) on effects of radiation on materials; Denver, CO (United States); 21-25 Jun 1992. Order Number DE93015825. Source: OSTI; NTIS; INIS; GPO Dep.

Critical components of the Advanced Neutron Source (ANS) reactor, to be built at Oak Ridge National Laboratory (ORNL), will be fabricated from 6061-T651 aluminum alloy. This alloy has been selected for its favorable neutronic, thermal, and mechanical properties. The effect of irradiation on the tensile properties and fracture toughness has been studied to allow the lifetime of these components to be estimated. Irradiations were carried out in the High Flux Isotope Reactor at ORNL at a temperature of approximately 95°C to a fluence of approximately 10^{26} m^{-2} (thermal). Testing was conducted from room temperature to 150°C. The yield and ultimate tensile strengths were increased by irradiation, and the total elongation decreased, but the fracture toughness at 26 and 95°C was not degraded by irradiation, and decreased only slightly at 150°C.

26586 (CONF-9208184–2) **Chemical and displacement atomic pair correlations in crystalline solid solutions recovered by anomalous x-ray scattering in Fe-Ni alloys.** Ice, G.E. (Oak Ridge National Lab., TN (United States)); Sparks, C.J.; Shaffer, L.B. Oak Ridge National Lab., TN (United States). [1992]. 30p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Anomalous scattering international conference; Malente (Germany); 17-21 Aug 1992. Order Number DE93015906. Source: OSTI; NTIS; GPO Dep.

Short-range pair correlations of atoms in crystalline solid solutions consist of both chemical and displacement correlations. Measurement of these pair correlations is fundamental to understanding the properties of solid solutions. We discuss anomalous scattering techniques which have provided an important advance in our ability to recover these pair correlations and to model the local atomic arrangements in crystalline solid solutions of Fe-Ni alloys.

26587 (CONF-921007–32) **Investigations of low-temperature neutron embrittlement of ferritic steels.** Farrell, K.; Mahmood, S.T.; Stoller, R.E.; Mansur, L.K. Oak Ridge National Lab., TN (United States). [1992]. 28p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC05-84OR21400. From 20. water reactor safety information meeting; Bethesda, MD (United States); 21-23 Oct 1992. Order Number DE93015460. Source: OSTI; NTIS; INIS; GPO Dep.

Investigations were made into reasons for accelerated embrittlement of surveillance specimens of ferritic steels irradiated at 50C at the High Flux Isotope Reactor (HFIR) pressure vessel. Major

suspects for the precocious embrittlement were a highly thermalized neutron spectrum,a low displacement rate, and the impurities boron and copper. None of these were found guilty. A dosimetry measurement shows that the spectrum at a major surveillance site is not thermalized. A new model of matrix hardening due to point defect clusters indicates little effect of displacement rate at low irradiation temperature. Boron levels are measured at 1 wt ppM or less, inadequate for embrittlement. Copper at 0.3 wt % and nickel at 0.7 wt % are shown to promote radiation strengthening in iron binary alloys irradiated at 50 to 60C, but no dependence on copper and nickel was found in steels with 0.05 to 0.22% Cu and 0.07 to 3.3% Ni. It is argued that copper impurity is not responsible for the accelerated embrittlement of the HFIR surveillance specimens. The dosimetry experiment has revealed the possibility that the fast fluence for the surveillance specimens may be underestimated because the stainless steel monitors in the surveillance packages do not record an unexpected component of neutrons in the spectrum at energies just below their measurement thresholds of 2 to 3 MeV.

26588 (CONF-921101–116) **Calculation of the thermopower of Ni-P amorphous alloys.** Swihart, J.C. (Indiana Univ., Bloomington, IN (United States). Dept. of Physics); Yang, H.; Nicholson, D.M.C. Oak Ridge National Lab., TN (United States). [1992]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 16. Material Research Society international symposium on the scientific basis for nuclear waste management fall meeting; Boston, MA (United States); 30 Nov - 5 dec 1992. Order Number DE93012960. Source: OSTI; NTIS; GPO Dep.

We have modeled the Ni-P amorphous alloy system by a set of supercells on which we have carried out calculations of electronic and transport properties. The thermopower is determined by calculating the energy dependence of the dc electrical conductivity from the Kubo formalism. At 15% P we find $-0.015\ \mu V/K^2$ for the thermopower divided by the temperature, while for 25% P the calculated value is $+0.008\ \mu V/K^2$, in reasonable agreement with experiment, particularly with regard to the change of sign with concentration.

26589 (CONF-921101–132) **Dynamical Ising model simulations of nucleation and growth in copper-cobalt alloys.** Cerezo, A. (Oxford Univ. (United Kingdom). Dept. of Materials); Hyde, J.M.; Setna, R.P.; Smith, G.D.W.; Miller, M.K. Oak Ridge National Lab., TN (United States). [1992]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Grant: GR/H/38485. From 16. Material Research Society international symposium on the scientific basis for nuclear waste management fall meeting; Boston, MA (United States); 30 Nov - 5 dec 1992. Order Number DE93015336. Source: OSTI; NTIS; GPO Dep.

A simple dynamical Ising model on a fixed lattice with a single bond energy parameter has been used to simulate the kinetics of diffusion during solid-state phase transformations in binary metallic alloys. Results of these simulations are compared with direct real-space measurements of the atomic distributions of elements in alloys, obtained with the position-sensitive atom probe. Despite the simplicity of the model, there is good quantitative agreement between the development of microstructure in the simulation and the nucleation and growth of cobalt-rich precipitates in copper-cobalt alloys.

26590 (CONF-921109–6) **The effect of long-term aging on the impact properties of modified 9Cr-1Mo steel.** Alexander, D.J.; Maziasz, P.J.; Brinkman, C.R. Oak Ridge National Lab., TN (United States). [1992]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Fall meeting of the Metallurgical Society and American Institute of Metallurgical and Petroleum Engineers; Chicago, IL (United States); 1-5 Nov 1992. Order Number DE93015453. Source: OSTI; NTIS; GPO Dep.

The Charpy impact and room-temperature tensile properties of two heats of modified 9Cr-1Mo steel have been examined after aging at temperatures from 482 to 704C for times up to 75,000 h. In general, aging at lower temperatures (482, 538, or 593C) resulted in little change in the room-temperature tensile properties, but rapid increases in the transition temperature, with the greatest increase for an aging time of 25,000 h. The upper-shelf energy level decreased, reaching a minimum at 25,000 h, followed by recovery at 50,000-h aging. At higher aging temperatures (649 and 704C) there was little change in the transition temperatures, but significant softening at room temperature, and large increases in the upper-shelf energy.

26591 (CONF-921109–7) **The effect of aging at 343°C on the mechanical properties and microstructure of type 308 stainless steel weldments.** Alexander, D.J.; Alexander, K.B.; Miller, M.K.; Nanstad, R.K. Oak Ridge National Lab., TN (United States). [1992]. 8p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC05-84OR21400. From Fall meeting of the Metallurgical Society and American Institute of Metallurgical and Petroleum Engineers; Chicago, IL (United States); 1-5 Nov 1992. Order Number DE93015454. Source: OSTI; NTIS; INIS; GPO Dep.

The effect of long-term aging at intermediate temperatures on the mechanical properties of stainless steel welds has been studied. Three type 308 multipass shielded metal-arc welds with ferrite levels of 4, 8, and 12% were aged up to 20,000 h at 343C. Tensile tests showed little effect of aging on either the yield or ultimate tensile strengths, but the impact toughness was significantly degraded. The extent of the degradation increased with increasing ferrite content and increasing aging time. Examination of the microstructure with transmission electron microscopy and atom probe field-ion microscopy revealed that the ferrite phase had undergone spinodal decomposition as a result of aging. In addition, G-phase particles were observed at dislocations, and finer G-phase particles were homogeneously distributed throughout the ferrite phase. The changes in the mechanical properties and the fractography are discussed in light of the observed changes in the microstructure.

26592 (CONF-9211110–2) **The influence of thermal aging on the microstructure and fatigue properties of modified 9Cr-1Mo steel.** Gieseke, B.G.; Brinkman, C.R.; Maziasz, P.J. Oak Ridge National Lab., TN (United States). [1992]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Microstructure and mechanical properties of aging materials; Detroit, MI (United States); 2-5 Nov 1992. Order Number DE93015489. Source: OSTI; NTIS; INIS; GPO Dep.

Results of elevated-temperature low cycle fatigue and creep-fatigue tests are for one heat of modified 9Cr-1Mo steel in the normalized and tempered condition, after pre-aging 50,000 h at 538 and 593C, and after pre-aging for 75,000 h at 538C. These data show that pre-aging reduces the low cycle fatigue and creep-fatigue lives in comparison to unaged material. The magnitude of these reductions are discussed along with the impact of pre-aging on the creep-fatigue damage diagrams. The effect of environment on creep-fatigue life of unaged modified 9Cr-1Mo steels is also addressed. Transmission electron microscopy explains changes in mechanical properties due to thermal aging. In the unaged alloy, TEM shows that dynamic recovery/recrystallization is occurring after significant strain-induced dislocation hardening around a stationary and stable array of as-tempered carbides during creep-fatigue. In contrast creep-fatigue testing of the pre-aged alloy produced a much coarser cellular subgrain structure and dislocation recovery without recrystallization. Aging causes as-tempered carbide dissolution and/or reprecipitation together with additional precipitation of Laves (Fe_2Mo) phase, which removes some of the precipitate-strengthening effects, and depletes solid-solution hardening effects on the dislocation networks and subgrain boundary structures.

26593 (CONF-9211117–9) **Environmental embrittlement in ordered intermetallic alloys.** Liu, C.T. (Oak Ridge National Lab., TN (United States)); Stoloff, N.S. Oak Ridge National Lab., TN (United States). [1992]. 34p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Minerals, Metals, and Materials Society/American Society for Metals (TMS/ASM) materials week '92; Chicago, IL (United States); 2-5 Nov 1992. Order Number DE93015307. Source: OSTI; NTIS; GPO Dep.

Ordered intermetallics based on aluminides and silicides possess many promising properties for elevated-temperature applications; however, poor fracture resistance and limited fabricability restrict their use as engineering material. Recent studies have shown that

environmental embrittlement is a major cause of low ductility and brittle fracture in many ordered intermetallic alloys. There are two types of environmental embrittlement observed in intermetallic alloys. One is hydrogen-induced embrittlement occurring at ambient temperatures in air. The other is oxygen-induced embrittlement in oxidizing atmospheres at elevated temperatures. In most cases, the embrittlements are due to a dynamic effect involving generation and penetration of embrittling agents (i.e., hydrogen or oxygen) during testing. Diffusion of embrittling agents plays a dominant role in fracture of these intermetallic alloys. This chapter summarizes recent progress in understanding and reducing environmental embrittlement in these alloys.

26594 (CONF-9211205–2) **Recent advances in ordered intermetallics.** Liu, C.T. Oak Ridge National Lab., TN (United States). [1992]. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From High-temperature ordered intermetallic alloys V; Boston, MA (United States); 30 Nov - 3 dec 1992. Order Number DE93015308. Source: OSTI; NTIS; GPO Dep.

This paper briefly summarizes recent advances in intermetallic research and development. Ordered intermetallics based on aluminides and silicides possess attractive properties for structural applications at elevated temperatures in hostile environments; however, brittle fracture and poor fracture resistance limit their use as engineering materials in many cases. In recent years, considerable efforts have been devoted to the study of the brittle fracture behavior of intermetallic alloys; as a result, both intrinsic and extrinsic factors governing brittle fracture have been identified. Recent advances in first-principles calculations and atomistic simulations further help us in understanding atomic bonding, dislocation configuration, and alloying effects in intermetallics. The basic understanding has led to the development of nickel, iron, and titanium aluminide alloys with improved mechanical and metallurgical properties for structural use. Industrial interest in ductile intermetallic alloys is high, and several examples of industrial involvement are mentioned.

26595 (CONF-930405–25) **Evolving surface cusps during strained-layer epitaxy.** Jesson, D.E. (Oak Ridge National Lab., TN (United States)); Pennycook, S.J.; Baribeau, J.M.; Houghton, D.C. Oak Ridge National Lab., TN (United States). Apr 1993. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Spring meeting of the Materials Research Society; San Francisco, CA (United States); 12-16 Apr 1993. Order Number DE93015430. Source: OSTI; NTIS; GPO Dep.

We have combined Z-contrast imaging and Ge marker layer experiments to study the evolving surface morphology of Si_xGe_{1-x} alloys grown by molecular beam epitaxy (MBE). Surface cusps are seen to arise as the intersection lines between coherent islands. The potential implications of stress concentrations associated with cusps are considered with a view to strain relaxation in the film via dislocation nucleation.

26596 (CONF-9305135–4) **Effects of alloying and temperature on the high-temperature oxidation of Cr-Cr_2Nb.** Tortorelli, P.F. (Oak Ridge National Lab., TN (United States)); DeVan, J.H.; Carson, L.J. Oak Ridge National Lab., TN (United States). [1993]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 7. annual conference on fossil energy materials; Oak Ridge, TN (United States); 11-13 May 1993. Order Number DE93015800. Source: OSTI; NTIS; GPO Dep.

Effects of alloying additions and temperature on isothermal and cyclic oxidation resistance of Cr-Cr_2Nb alloys were examined for air exposures. An isothermal exposure temperature of 1100C led to rapid reaction of binary Cr-12 at.% Nb as manifested a high oxidation rate and nonprotective behavior. Generally parabolic kinetics, complicated by some isothermal scale cracking, were observed at 900–1000C. Scale damage was exacerbated by thermal cycling. The addition of 8 at.% Al to Cr-12 at.% Nb did not effect cyclic oxidation resistance, but there was some evidence that scale adherence on Cr-6 at.% Nb-8 at.% Al was better than that for binary Cr-6 at.% Nb. Alloying additions of Al (up to 18 at.%) or Re (2 at.%) did not improve the isothermal oxidation resistance of Cr-12 at.% Nb. However, the tendency for scale damage during both isothermal and thermal cycling exposures suggests that alloying additions that specifically improve scale plasticity or modify growth stresses could be effective for Cr-Nb alloys. 10 refs, 9 figs, 1 tab.

26597 (CONF-9305135–5) **Environmental effects on iron aluminides.** DeVan, J.H.; Tortorelli, P.F. Oak Ridge National Lab., TN (United States). [1993]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 7. annual conference on fossil energy materials; Oak Ridge, TN (United States); 11-13 May 1993. Order Number DE93015820. Source: OSTI; NTIS; GPO Dep.

Corrosion properties of reference Fe_3Al (28 at. % Al)-based compositions containing 2 and 5 at. % Cr were compared in a mixed gas composed of H_2S-H_2-H_2O-Ar and in dehumidified air. The parabolic rate constant at 800C was a factor of 200 higher for the 5% Cr composition. Similar exposure of an alloy containing 16% Al and 5% Cr resulted in significantly higher weight gains than the Fe_3Al – 5% Cr composition. However all the alloys were significantly more resistant to the mixed gas than iron-based alloys with higher chromium and lower aluminum contents. The oxidation rates of the 2 and 5% Cr alloys were comparable in dry air at 800C and were a factor of two lower than the rate of the 2% Cr alloy in the mixed gas. An alloy of Fe with 16% Al, 5% Cr, and 0.1% Zr showed improved cyclic oxidation resistance in air at 900 and 1000C relative to binary alloys of 16 and 20% Al. The extent of oxidation of these 16% Al alloys was comparable to Zr-containing Fe_3Al aluminides (28% Al) that develop adherent scales.

26598 (CONF-930803–13) **Design of a cruciform bend specimen for determination of out-of- plane biaxial tensile stress effects on fracture toughness for shallow cracks.** Bass, B.R.; Bryson, J.W.; Mcafee, W.J.; Pennell, W.E.; Theiss, T.J. Oak Ridge National Lab., TN (United States). [1993]. 12p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC05-84OR21400. From 12. biennial conference for the International Association for Structural Mechanics in Reactor Technology (SMIRT 12); Stuttgart (Germany); 16-26 Aug 1993. Order Number DE93015455. Source: OSTI; NTIS; INIS; GPO Dep.

Pressurized-thermal-shock loading in a reactor pressure vessel produces significant positive out-of-plane stresses along the crack front for both circúmferential and axial cracks. Experimental evidence, while very limited, seems to indicate that a reduction in toughness is associated with out-of-plane biaxial loading when compared with toughness values obtained under uniaxial conditions. A testing program is described that seeks to determine the effects of out-of-plane biaxial tensile loading on fracture toughness of RPV steels. A cruciform bend specimen that meets specified criteria for the testing pregam is analyzed using three-dimensional elastic-plastic finite-element techniques. These analysis results provide the basis for proposed test conditions that are judged likely to produce a biaxial loading effect in the cruciform bend specimen.

26599 (CONF-930997–2) **A reexamination of grain boundary fracture in Ni_3Al: Environmental and alloying effects.** George, E.P. (Oak Ridge National Lab., TN (United States)); Liu, C.T.; Pope, D.P. Oak Ridge National Lab., TN (United States). [1993]. 9p. Sponsored by USDOE, Washington, DC (United States); National Science Foundation, Washington, DC (United States). DOE Contract AC05-84OR21400. Grant: DMR/MRL91-20668. From International symposium on structural intermetallics; Champion, PA (United States); 26-30 Sep 1993. Order Number DE93015431. Source: OSTI; NTIS; GPO Dep.

The intrinsic room-temperature ductility (~23%) of polycrystalline Ni_3Al is considerably higher than previously thought. Environmental embrittlement, caused by moisture in ordinary ambient air, reduces significantly the maximum attainable ductility in air. Microcracks (introduced during processing) can also reduce the maximum attainable ductility in air. A consequence of these extrinsic factors is that polycrystalline Ni_3Al is usually found to be quite brittle in air, and very careful experimental procedures are required if its (higher) intrinsic ductility is to be measured. The addition of B essentially suppresses environmental embrittlement in Ni_3Al, thereby improving ductility. The substitutional elements Zr and Hf also improve ductility, but Ti (which is from the same group in the periodic table) does not. The mechanism by which Zr and Hf improve ductility is not known, but they appear to both alleviate environmental embrittlement and enhance grain-boundary cohesion.

26600 (CONF-930997–3) **Development and commercialization status of Fe_3Al-based intermetallic alloys.** Sikka, V.K.; Viswanathan, S.; McKamey, C.G. Oak Ridge National Lab., TN (United States). [1993]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From International symposium on structural intermetallics; Champion, PA (United States); 26-30 Sep 1993. Order Number DE93015802. Source: OSTI; NTIS; GPO Dep.

The Fe_3Al-based intermetallic alloys offer unique benefits of excellent oxidation and sulfidation resistance, limited by poor room-temperature (RT) ductility and low high-temperature strength. Recent understanding of environmental effects on RT ductility of these alloys has led to progress toward taking commercial advantage of Fe_3Al-based materials. Cause of low ductility appears to be related to hydrogen formed from reaction with moisture. The environmental effect has been reduced in these intermetallic alloys by two methods. The first deals with producing a more hydrogen-resistant microstructure through thermomechanical processing, and the second dealed with compositional modification. The alloys showing reduced environmental effect have been melted and processed by many different methods. Laboratory and commercial heats have been characterized. Tests have been conducted in both air and controlled environments to quantify environmental effects on these properties. These materials were also tested for aqueous corrosion and resistance to stress corrosion cracking. Oxidation and sulfidation data were generated and effects of minor alloying elements on were also investigated. Several applications have been identified for the newly developed iron aluminides. Commercialization status of these alloys is described.

26601 (DOE/ER/45141–9) **[A microstructural approach to fatigue crack processes in poly crystalline BCC materials]: Progress report.** Gerberich, W.W. Minnesota Univ., Minneapolis, MN (United States). Dept. of Chemical Engineering and Materials Science. [1992]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-84ER45141. Order Number DE93016666. Source: OSTI; NTIS; GPO Dep.

Objective was to study fatigue where a combination of low temperature and cyclic loading produced cyclic cleavage in bcc Fe-base systems. Both dislocation dynamics and quasi-statics of crack growth were probed. This document reviews progress over the past 6 years: hydrogen embrittlement and cleavage, computations (stress near crack tip), disiocation emission from grain boundaries, fracture process zones, and understanding brittle fracture at the atomistic/dislocation scales and at the microscopic/macroscopic scale.

26602 (DOE/ER/45315–17) **Boundary stability under nonequilibrium conditions: Progress report.** Michigan Technological Univ., Houghton, MI (United States). [1993]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-87ER45315. Order Number DE93016259. Source: OSTI; NTIS; GPO Dep.

Purpose of this work is to study microscopic, nanometer-scale behavior of interfaces under nonequilibrium conditions prevailing during service or materials processing. The need is to study grain boundary and surface/thin film instabilities under applied stress and chemical diffusion. This document is divided into: grain boundaries (stability, dislocations under applied stress, structural stability of grain boundaries during DIGM and under applied stress) and surfaces/thin films (hillock growth on microcrystalline and single crystal surfaces, plate edge instabilities, coherently strained islands). 31 refs.

26603 (DOE/ER/45461–2) **[Fundamental studies of passivity and passivity breakdown].** Macdonald, D.D. Pennsylvania State Univ., University Park, PA (United States). Center for Advanced Materials. [1993]. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-91ER45461. Order Number DE93017052. Source: OSTI; NTIS; GPO Dep.

We developed and experimentally tested physical models for growth and breakdown of passive films on metal surfaces. These models are "point defect models," in which the growth and breakdown are described in terms of movement of anion and cation vacancies. The work during the past 5 years resulted in: theory of growth and breakdown of passive films, theory of corrosion-resistant alloys, electronic structure of passive films, and estimation of damage functions for energy systems. Proposals are give for the five ongoing tasks. 10 figs.

26604 (DOE/ER/45461–9) **Critical issues in the use of metals and alloys in sulphur-containing aqueous systems.** Macdonald, D.D. Pennsylvania State Univ., University Park, PA (United States). Center for Advanced Materials. [1992]. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-91ER45461. (CONF-9208224–1: 31. annual conference of metallurgists on materials performance, sulphur and energy, Edmonton (Canada), 24-27 Aug 1992). Order Number DE93012924. Source: OSTI; NTIS; GPO Dep.

Sulphur-containing aqueous fluids are amongst the most corrosive environments experienced in industrial and natural systems. The high corrosivity is due principally to the wide range of oxidation states that sulphur may exist in within the thermodynamic stability domain of water, as well as to the high lability of many sulphur species, such as the polythionic acids and polysulfides. Additionally, sulphur, along with arsenic, antimony, and mercury, effectively promotes the entry of hydrogen into metal and alloy matrices, thereby leading to hydrogen damage and hydrogen embrittlement. In this paper, the chemistry of sulphur species in aqueous solutions and of the various iron sulphides is reviewed with emphasis on illustrating the diverse nature of metal/sulphur interactions. Finally, we identify a number of critical issues that need to be resolved to greatly improve our understanding of the chemistry of sulphur-containing systems and to improve our ability to predict the form and extent of corrosion in geochemical and geoenergy systems.

26605 (DOE/ER/45461–10) **Vacancy condensation as the precursor to passivity breakdown.** Macdonald, D.D. Pennsylvania State Univ., University Park, PA (United States). Center for Advanced Materials. [1993]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-91ER45461. (CONF-930998–1: Fall committee week of the National Association of Corrosion Engineers, Houston, TX (United States), 26 Sep - 1 oct 1993). Order Number DE93012925. Source: OSTI; NTIS; GPO Dep.

This paper outlines the events that are envisaged to occur, according to the Point Defect Model (PDM), during "chemically-induced" breakdown of the barrier layer on passivated metals and alloys in aqueous environments. The essential hypothesis of the model is that the local generation of cation vacancies at the barrier layer/environment interface, due to the autocatalytic adsorption of a damaging species such as chloride ion into the oxygen vacancy structure, leads to an enhanced flux of cation vacancies across the film. If the vacancies that arrive at the metal/film interface cannot be annihilated by cation ejection from the metal, the vacancies will condense leading to the local decohesion of the barrier layer from the metal. A combination of film dissolution at the barrier layer/environment interface and residual stresses in the oxide film leads to the physical rupture of the film, marking a passivity breakdown event. The PDM accounts for a variety of empirically-established relationships for the nucleation of pits, including the fact that the breakdown voltage (V_c) and induction time (t_{ind}) are distributed quantities; that $V_c = V_c^\circ$ - blog (a_{Cl^-}), where $b > 2.303RT/F$; and that log (t_{ind})α $1/\Delta V$, where ΔV = V (applied voltage) - V_c. Also, the model has been extended to account for alloying effects and, indeed, new alloys are now being designed on the basis of rules that have been derived from the PDM.

26606 (DOE/ER/45461–22) **Fundamental studies on passivity and passivity breakdown.** Macdonald, D.D.; Urquidi-Macdonald, M. Pennsylvania State Univ., University Park, PA (United States). [1993]. 123p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-91ER45461. (CONF-9306175–1: OPA peer review on electrochemistry and aqueous corrosion of materials: aqueous corrosion emphasis, Washington, DC (United States), 17 Jun 1993). Order Number DE93015501. Source: OSTI; NTIS; GPO Dep.

Using photoelectrochemical impedance and admittance spectroscopies, a fundamental and quantitative understanding of the mechanisms for the growth and breakdown of passive films on metal and alloy surfaces in contact with aqueous environments is

being developed. A point defect model has been extended to explain the breakdown of passive films, leading to pitting and crack growth and thus development of damage due to localized corrosion.

26607 (ETDE-IT–93-185) **Correlation between X-ray diffraction line profile analysis and solid state reactions induced by mechanical alloying of elemental powders.** Guo, W.; Martelli, S.; Magini, M.; Padella, F.; Paradiso, E. ENEA, Casaccia (Italy). Area Energia e Innovazione. 1992. 6p. (CONF-9207207–1: European powder diffraction conference, Enschede (Netherlands), 30 Jul - 1 aug 1992). Order Number DE93799199. Source: OSTI; NTIS (US Sales Only).

Within the framework of research studies on the feasibility of forming amorphous alloys by the mechanical alloying of elemental powders, this paper reports on the application of the Fourier diffraction method of Warren-Averbach (developed to measure external stress-induced strain) to mechanically alloyed $Pd_{80}Si_{20}$ samples which showed a progressive transition from the crystalline to the amorphous state upon ball milling. The Pd reflections presented, during alloying, an increasing broadening, which could not be simply referred to defects introduced by powder cold working. From the logarithm-quotient Warren plot, a function proportional to $L=na_3$ in the physical space could be derived. The measured function of L fulfilled, in the early stages of alloying, the para-crystal concept, suggesting that the mechanically driven diffusion of Si into Pd caused para-crystalline distortion of the host lattice. However, direct connections between lattice distortions and amorphous phase formation could not be established on the basis of the present results.

26608 (INIS-mf–12758, pp. 17-24) **Iron oxides photochemical dissolution.** Blesa, M.A. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina). Dept. de Quimica de Reactores); Litter, M.I. Asociacion Argentina de Tecnologia Nuclear, Buenos Aires (Argentina). 1987. [735p.] (In Spanish). (CONF-8711355–: 15. scientific meeting and 4th Latin American meeting and 1st sessions on nuclear power plants, San Carlos de Bariloche (Argentina), 2-6 Nov 1987). In *Proceedings of the fifteenth scientific meeting; fourth Latin American meeting; first sessions on nuclear power plants.* Order Number DE91003052. Source: OSTI; NTIS (US Sales Only); INIS.

This work was intended to study the light irradiation influence of diverse wave-lengths on iron oxides dissolution in aqueous solutions. The objectives of this work were: the exploration of photochemical processes with the aim of its eventual application in: (a) decontamination and chemical cleaning under special conditions; (b) materials for solar energy conversion. (Author).

26609 (INIS-mf–12758, pp. 245-260) **Zircaloy 4 ingots' industrial fabrication: Actual development state.** Leyt, A. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina). Gerencia de Procesos Quimicos). Asociacion Argentina de Tecnologia Nuclear, Buenos Aires (Argentina). 1987. [735p.] (In Spanish). (CONF-8711355–: 15. scientific meeting and 4th Latin American meeting and 1st sessions on nuclear power plants, San Carlos de Bariloche (Argentina), 2-6 Nov 1987). In *Proceedings of the fifteenth scientific meeting; fourth Latin American meeting; first sessions on nuclear power plants.* Order Number DE91003052. Source: OSTI; NTIS (US Sales Only); INIS.

The technology developed for the industrial fabrication of Zircaloy-4 ingots is presented. According to the results obtained: (a) the homogeneity of the ingots is analyzed, regarding the distribution of components (tin, iron, chromium, oxygen) and Brinell hardness as a function of different types of charge: zirconium sponge-recycling alloy material, sponge of zirconium-alloy; (b) the distribution of the same parameters as a function of production is also analyzed. (Author).

26610 (INIS-mf–13544) **Radiation materials science. V. 5.** Zelenskij, V.F. (ed.). AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. [232p.] (In Russian, English). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). Order Number DE93630453. Source: OSTI; NTIS (US Sales Only); INIS.

This volume includes the papers of the international conference on radiation materials in Alushta, Ukraine in May 1990. The main topics are: basic research in radiation damage physics, a study of the structural materials for reactor cores; irradiation effect on reactor vessel, fuel, super- and semiconductor materials; investigation damage research methods.

26611 (INIS-mf–13544, pp. 3-10) **Space and time dissipation structures in impurity crystals under irradiation.** Selishchev, P.A. (AN Ukrainskoj SSR, Kiev (Ukraine). Inst. Yadernykh Issledovanij); Sugakov, V.I. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 5.* [232p.] Order Number DE93630453. Source: OSTI; NTIS (US Sales Only); INIS.

Self-organization of elastically interacting defect density and development of dissipative in space and time concentration structures of proper defects and impurity atoms, temperature of irradiated crystals were investigated. It is shown that at critical conditions of irradiation the stationary and homogeneous defect distribution becomes unstable and a dissipative structure is formed. Crystal properties, form of irradiation and heat removal define its type and parameters. 11 refs.; 3 figs. (J.P.).

26612 (INIS-mf–13544, pp. 11-18) **A model of the effective lossy medium for a binary alloy under irradiation.** Bakai, A.S. (AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst.); Turkin, A.A. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 5.* [232p.] Order Number DE93630453. Source: OSTI; NTIS (US Sales Only); INIS.

The kinetics of vacancies and interstitials produced by irradiation in a binary alloy with complete is considered. No elastic interaction between point defects and sinks is assumed to exist. At sinks the concentrations of vacancies and interstitials are fixed at their thermal equilibrium values. Despite radiation-induced segregation causing local changes in composition around sinks, all sinks remain unbiased toward absorption of defects of a certain type, i.e. segregation alone does not lead to preferential loss of either vacancies of interstitials at a given sink. The balance equations for the average defect concentrations are derived. It is shown that the solute concentration at a sink does not depend on its geometry. 13 refs.; 1 fig.; 1 tab. (author).

26613 (INIS-mf–13544, pp. 55-62) **The mechanism of cascade vacancy loop nucleation in HCP zirconium.** Kapinos, V.G. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (Russian Federation). Inst. Atomnoj Ehnergii); Osetskij, Yu.N.; Platonov, P.A. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 5.* [232p.] Order Number DE93630453. Source: OSTI; NTIS (US Sales Only); INIS.

A diffusive rearrangement of non-equilibrium depleted zone (DZ) at the thermal stage of cascade development is investigated in Zr using the dynamical computer simulation. At concentrations of vacancies in DZ $C\text{-bar}_v$=10 at.% nucleation of prism loops with the Burgers vectors b=1/3<1120> was predominant. At DZ vacancy concentration $C\text{-bar}_v$=15 at.%, basal loops with Burgers vectors b=1/6<2023> nucleate along with prism ones. It is suggested that nucleation of prism loops in zirconium might be affected by processes related to polymorphic transformation in cascade region. 9 refs.; 2 figs.; 1 tab. (author).

26614 (INIS-mf–13544, pp. 63-69) **Positron spectroscopy of radiation defects of vanadium.** Maev, S.N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk (Russian Federation). Fiziko-Ehnergeticheskij Inst.); Miron, N.F. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 5.* [232p.] Order Number DE93630453. Source: OSTI; NTIS (US Sales Only); INIS.

The interstitial impurity atoms effect on the annealing of the neutron irradiation, electron irradiation and deformation induced defects has been investigated for the single crystal vanadium. It was found that the non-annealed single crystal vanadium contains the microvoids. The defects annealing stages in the temperature range 20-560^{0}C were observed for electron irradiated and deformed vanadium. The processes proceeding in those stages are discussed. 11 refs.; 3 figs.; 1 tab. (author).

26615 (INIS-mf–13544, pp. 89-96) **About the role of divacancies and diinterstitials in the theory of homogeneous nucleation of radiation-induced voids in metals.** Bondarenko, A.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk (Russian Federation). Fiziko-Ehnergeticheskij Inst.); Chernov, V.M. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 5.* [232p.] Order Number DE93630453. Source: OSTI; NTIS (US Sales Only); INIS.

The system of stiff non-linear differential equations describing the kinetics of vacancy voids and interstitial dislocation loops nucleation and growth in pure metal (nickel) is solved with the high mobilities of divacancies and diinterstitials taken into account. The calculated time dependences of void nucleation rate are present and discussed, the dependences of other values calculated are briefly described. It is shown that the account of di-defects mobility results in significant increase of void nucleation rate. However, the rates obtained are not high enough to meet the void concentration usually observed at highest temperatures of void formation. 13 refs.; 1 fig.; 1 tab. (author).

26616 (INIS-mf–13544, pp. 97-103) **About homogeneous nucleation of vacancy voids.** Demin, N.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk (Russian Federation). Fiziko-Ehnergeticheskij Inst.). AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 5.* [232p.] Order Number DE93630453. Source: OSTI; NTIS (US Sales Only); INIS.

Calculated results on vacancy void nucleation in irradiated metals are presented. The model of homogeneous void nucleation was investigated with preferentially absorb voids interstitials with respect to vacancies. It is shown that the void nucleation rate is much below homogeneous nucleation rate which was calculated in the frame of classical model. The temperature interval of void nucleation was found more narrow that also contradict available results, which were obtained with using the saddle point method. 11 refs.; 3 figs.

26617 (INIS-mf–13544, pp. 81-88) **Radiation effects in thin films on the conducting materials surface.** Suvorov, A.L. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (Russian Federation). Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 5.* [232p.] Order Number DE93630453. Source: OSTI; NTIS (US Sales Only); INIS.

Transformation of structure, composition and some properties of solid state system thin film (thickness in the range from one to ten atomic layers) massive substrate under the irradiation by low energy gas ions (with energies from several hundreds to ten thousand eV) is considered. Among basis processes, contributing to the evolution of such system the following processes are analyzed: defects formation, atomic (cascadeless) mixing, sputtering and erosion, diffusion. Some data of experimental investigation of these processes by field electron and field ion microscopy methods are given. 20 refs.; 4 figs. (author).

26618 (INIS-mf–13544, pp. 104-111) **Calculation of point defect sink strengths in binary and ternary substitutional alloys.** Pechenkin, V.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk (Russian Federation). Fiziko-Ehnergeticheskij Inst.); Epov, G.A. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 5.* [232p.] Order Number DE93630453. Source: OSTI; NTIS (US Sales Only); INIS.

Analytical expressions for the stationary component profiles of binary and ternary substitutional alloys in the vicinity of point defect sinks under irradiation are derived. It is shown, that the slowest component must be segregated at the sinks, but the two other components must migrate away from the sinks in ternary alloys with vacancy mechanism of radiation-induced segregation. The segregation-induced biases of different kinds of sinks are calculated by means of spatial component distributions obtained. 9 refs.; 3 figs.; 1 tab. (author).

26619 (INIS-mf–13544, pp. 112-120) **Theory of the void nucleation in crystals under intensive irradiation.** Dubinko, V.I. (AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst.). AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 5.* [232p.] Order Number DE93630453. Source: OSTI; NTIS (US Sales Only); INIS.

Effect of image interaction of voids with point defects on the void nucleation in materials supersaturated with vacancies and interstitials is investigated. Analytical expressions is derived for the stationary nucleation rate in the limit of infinite supersaturation which corresponds to a sufficiently high dose rate (or low temperature) of irradiation. In this limit the nucleation rate is shown to be independent of irradiation conditions and to be determined by the constants of interaction of point defects with voids and dislocations. The theory predicts higher nucleation rates for bcc metals as compared to fcc ones which is in agreement with experimental observations. 10 refs.; 1 fig. (author).

26620 (INIS-mf–13544, pp. 129-133) **Atomic mixing of metals.** Zabolotnyj, V.T. (AN SSSR, Sverdlovsk (Russian Federation). Inst. Ehkologii Rastenij i Zhivotnykh); Ivanov, L.I. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 5.* [232p.] Order Number DE93630453. Source: OSTI; NTIS (US Sales Only); INIS.

It is proposed to use the model of dynamic mass transfer for choosing conditions and forecasting the results of ion treatment for producing homogeneous of elements which are non-soluble under equilibrium conditions. 7 refs.; 4 figs. (author).

26621 (INIS-mf–13544, pp. 150-157) **Phase structural changes in nickel alloys in the process of thermal ageing and under irradiation.** Uvarov, N.V. (Vsesoyuznyj Nauchno-Issledovatel'skij Inst. Neorganicheskikh Materialov, Moscow (Russian Federation)); Sokurskij, Yu.N.; Mironova, E.G.; Bryk, V.V. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 5.* [232p.] Order Number DE93630453. Source: OSTI; NTIS (US Sales Only); INIS.

Results of the investigation of structure and properties of a number of high-nickel and model alloys in different structural conditions after simulation irradiation by helium, heavy ions and after reactor irradiation by neutrons are presented. 4 refs.; 5 figs.; 2 tabs.

26622 (INIS-mf–13544, pp. 158-165) **Structural state in ion irradiated metal systems.** Khmelevskaya, V.S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk (Russian Federation). Fiziko-Ehnergeticheskij Inst.); Solov'ev, S.P.; Malynkin, V.G.; Kudrya, E.V. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 5.* [232p.] Order Number DE93630453. Source: OSTI; NTIS (US Sales Only); INIS.

Using the methods of structure investigations it was found that irradiation of Fe-Ni, Fe-Cr-Ni, Ni-Cr and Fe-Cr solid solutions initiates transformation to a new phase state which proceeds within some dose, temperature and flux density ranges. This new state is non-equilibrium one because it can be eliminated as a result of subsequent annealing at irradiation or lower temperatures. Specific features of the state permit to treat it as a dissipative structure predicted within the frames of thermodynamics of irreversible processes. 2 refs.; 6 figs. (author).

26623 (INIS-mf–13544, pp. 165-170) **Phase stability of ordered alloys under irradiation.** Bakaj, A.S. (AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst.); Fateev, M.P. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 5.* [232p.] Order Number DE93630453. Source: OSTI; NTIS (US Sales Only); INIS.

A method is proposed to build the effective free energy of the binary ordered alloy under irradiation. A general procedure is developed to construct phase diagrams of irradiated ordered alloys. As an example, the alloy of the Cu_3Au-type is considered. Using the kinetic equation for the long range order and taking into account the vacancy mechanism of ordering, the Lyapunov function, which is an analog of the free energy of the alloy under irradiation, is found in the Bragg-Williams approximation. The developed approach is applied to calculate the phase diagram and the spinodal for the alloy of the Cu_3Au-type. 7 refs.; 2 figs. (author).

26624 (INIS-mf–13544, pp. 179-186) **Stacking fault density as engineering criterion for resistance to radiation swelling of alloys' FCC- and BCC-lattice.** Zheltov, Yu.V. (Opytnoe Konstruktorskoe Byuro Mashinostroeniya, Gor'kij (Russian Federation)); Ageev, V.S.; Kolesnikov, Yu.G. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 5.* [232p.] Order Number DE93630453. Source: OSTI; NTIS (US Sales Only); INIS.

The experimental data on influence of Mn, Cr, Ni, P, B, Ce alloying in austenitic and simultaneously Nb, V, B alloying in ferritic steels and also heat treatment on stacking fault density (SFD) are represented. In all cases besides influence of Cr in austenitic steel the increase of SFD is shown. The decrease of radiation swelling of industrial steels at the increase of their SFD, measured by X-rays, was studied. The tendency of increase of relative radiation swelling change at SFD increase at relative fluence rise is verified. It is shown that SFD may be a perspective proximate characteristics of choice of radiation-resistant steel melts within one steel quality. 14 refs.; 4 figs. (author).

26625 (INIS-mf–13544, pp. 195-201) **Study of swelling copper alloys irradiated by heavy Ions.** Barabash, V.P. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (Russian Federation)); Naberenkov, A.V.; Nesterova, E.V.; Rybin, V.V.; Fabritsiev, S.A. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 5.* [232p.] Order Number DE93630453. Source: OSTI; NTIS (US Sales Only); INIS.

Radiation swelling and microstructure changes in prospective copper alloys after ion irradiation were investigated. It was shown that dispersion-consolidated types of alloys are the most prospective materials for energy-stressed elements of thermonuclear reactors from the swelling stability point of view. 14 refs.; 5 figs. (J.P.).

26626 (INIS-mf–13544, pp. 171-178) **Radiation-acoustic studies of materials with non-linear thermoelastic properties.** Uvarov, V.T. (AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst.); Slezov, V.V.; Popov, G.F.; Kalinichenko, A.I. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 5.* [232p.] Order Number DE93630453. Source: OSTI; NTIS (US Sales Only); INIS.

Radiation acoustic methods are used to investigate the dynamics of phase transitions in materials with non-linear thermoelastic properties, including alloys with a shape memory effect, rare-earth metals, high-Tc ceramics, etc. The temperature dependence of the Grueneisen parameter and the elastic modulus of the materials under study are shown to be sensitive to the concentration of the constituents, alloy components and gas saturation. Discussed are possible methods of control of the parameters, absorbed energy field and the phase state of the materials under radiation action of pulsed high-current relativistic electron beams. 5 refs.; 4 figs. (author).

26627 (INIS-mf–13544, pp. 202-209) **Vacancy and impurity complexes in the Ni-Sc system and their influence on the radiation swelling.** Gann, V.V. (AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst.); Marchenko, I.G.; Neklyudov, I.M.; Petrusenko, Yu.T.; Sleptsov, A.N. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 5.* [232p.] Order Number DE93630453. Source: OSTI; NTIS (US Sales Only); INIS.

Experimental research and mathematic modelling of impurity complexes formation processes and their influence on radiation swelling processes are presented. 19 refs.; 5 figs. (author).

26628 (INIS-mf–13545) **Radiation materials science. V. 6.** Zelenskij, V.F. (ed.). AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. [218p.] (In Russian, English). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). Order Number DE93630454. Source: OSTI; NTIS (US Sales Only); INIS.

This volume includes the papers of the international conference on radiation materials in Alushta, Ukraine in May 1990. The main topics are: basic research in radiation damage physics, a study of the structural materials for reactor cores; irradiation effect on reactor vessel, fuel, super- and semiconductor materials; investigation damage research methods.

26629 (INIS-mf–13545, pp. 3-11) **The effect of radiation-induced segregation on shape and growth rate of vacancy voids.** Bakaj, A.S. (AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst.); Borodin, O.V.; Bryk, V.V.; Voevodin, V.N.; Neklyudov, I.M.; Platonov, P.V.; Turkin, A.A. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 6.* [218p.] Order Number DE93630454. Source: OSTI; NTIS (US Sales Only); INIS.

Microstructural changes have been studied in Kh18N10T steel in BOR-60 up to 40 dpa at 580-600^{0}C. It was found out that in the vicinity of the voids associated with G-phase precipitates the composition of steel is practically the same as the average matrix one, whereas the isolated voids are surrounded by Ni and Si enriched zones. The shape and size of a void depend on local composition near it - the mean size of octahedral voids (associated with G-phase) is greater than that of cubic voids. The theoretical model is developed to explain the observed differences between growth rates of isolated and precipitate-attached voids. 10 refs.; 2 figs.; 1 tab. (author).

26630 (INIS-mf–13545, pp. 12-27) **Express-analysis of irradiated steel mechanical properties.** Tsepelev, A.B. (AN SSSR, Moscow (Russian Federation). Inst. Metallurgii); Bystrov, L.N.; Pojmenov, I.L.; Kulikova, O.I. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 6.* [218p.] Order Number DE93630454. Source: OSTI; NTIS (US Sales Only); INIS.

A rather high sensibility of the miniature disk bending method which permits to fix small effects connected with saturation of a material with radiation-formed point defects was demonstrated on

example of electron irradiation influence on mechanical properties of austenitic stainless steels. 9 refs.; 7 figs.; 2 tabs. (J.P.).

26631 (INIS-mf–13545, pp. 28-33) **Helium atom doping of molybdenum and its influence on the radiation hardenings.** Vagin, S.P. (AN Kazakhskoj SSR, Alma-Ata (Kazakhstan). Inst. Yadernoj Fiziki); Loktionov, A.A.; Reutov, V.F. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 6.* [218p.] Order Number DE93630454. Source: OSTI; NTIS (US Sales Only); INIS.

Experimental results on study of helium concentration influence on degree of molybdenum radiation hardening for various method of cyclotron doping differing in degree and damage character are presented. It is established that accumulation of helium atoms in molybdenum for simultaneous formation of radiation defects caused by low energetic primary-knocked atoms leads to higher degree of hardening than for high energetic ion irradiation. It is shown that with increase of helium atom concentration the degree of radiation hardening for the same level of damage increases. 4 refs.; 3 figs. (author).

26632 (INIS-mf–13545, pp. 34-49) **Influence of helium and hydrogen on the embrittlement of construction materials with fcc- and bcc-lattices.** Rybin, V.V. (Tsentral'nyj Nauchno-Issledovatel'skij Inst. Konstrktsionnykh Materialov, S. Peterburg (Russian Federation)); Fabritsiev, S.A.; Zhdan, G.T.; Reutov, V.F. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 6.* [218p.] Order Number DE93630454. Source: OSTI; NTIS (US Sales Only); INIS.

An attempt of critical comparative analysis of helium embrittlement (HE) tendencies in austenite alloy with high content of nickel X20H45 (fcc) and ferrite steel X13M1 (bcc) was made. It was shown that a strong influence of the high-temperature deformation velocity on HE in austenite materials exists and a noticeable intensification of HE was detected when the deformation velocity is lowered. Influence of helium on high-temperature mechanical properties of austenite alloy and ferrite steel in general is the same. The discovered effect of HE sharp increase in case of hydrogen adding requires a further study. 13 refs.; 7 figs. (J.P.).

26633 (INIS-mf–13545, pp. 50-53) **Influence of irradiation with 20 MeV hydrogen and helium ions on the structure and properties of construction materials and semi-conductors.** Zabrodin, B.V. (Nauchno-Proizvodstvennoe ob'edinenie "Pozitron", S. Peterburg (Russian Federation)); Kozlovskij, V.V.; Fabritsiev, S.A.; Shustrov, B.A. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 6.* [218p.] Order Number DE93630454. Source: OSTI; NTIS (US Sales Only); INIS.

Processes of gas embrittlement in thermonuclear reactor construction materials induced by protons and alpha-particles as well as processes of semi-conductor materials transmutation (nuclear) doping were investigated. 4 refs.; 1 tab. (J.P.).

26634 (INIS-mf–13545, pp. 54-59) **Helium atoms behaviours in aluminium and its alloys.** Zaritskij, N.S. (AN Ukrainskoj SSR, Kiev (Ukraine). Inst. Yadernykh Issledovanij); Karasev, V.S.; Tsybul'ko, Yu.A. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 6.* [218p.] Order Number DE93630454. Source: OSTI; NTIS (US Sales Only); INIS.

The aluminium and its alloys specimens AMg and AMg(Sc) irradiated to the different doses by the low-energy helium ions from the glow discharge plasma at the temperature of $\approx 350^0$C were investigated by the internal friction method, thermodesorption method, optical and transmission electron microscopy method. The dose dependences of the grain boundary maximum height changing were made. The helium binding energy with the grain-boundary traps was calculated. The helium concentration in the samples corresponded to the grain boundaries adsorption saturation and investigated materials inclination to swelling were estimated. 11 refs.; 3 figs.; 1 tab. (author).

26635 (INIS-mf–13545, pp. 60-66) **Anelastic relaxation properties of nickel and 0Cr16Ni11Mo3 steel with rare-earth additions.** Karasev, V.S. (AN Ukrainskoj SSR, Kiev (Ukraine). Inst. Yadernykh Issledovanij); Grinik, Eh.U.; Neklyudov, I.M.; Ozhigov, L.S.; Parkhomenko, A.A. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 6.* [218p.] Order Number DE93630454. Source: OSTI; NTIS (US Sales Only); INIS.

Investigations are reported of different kinds of irradiation (neutrons, electrons) on the anelastic relaxation properties for nickel and 0Kh16N11M3 steel with rare-earth additions. It was experimentally obtained, the grain boundary temperature of internal friction (Ke-peak) decreased. Effect connected with the fact that points of strong fasten appeared account of diffusion of scandium and praseodymium to the grain boundaries. 3 refs.; 4 figs. (author).

26636 (INIS-mf–13545, pp. 67-72) **Absorption of radiation vacancies by grain boundaries in metal and steels.** Grinik, Eh.U. (AN Ukrainskoj SSR, Kiev (Ukraine). Inst. Yadernykh Issledovanij); Totskij, A.Yu. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 6.* [218p.] Order Number DE93630454. Source: OSTI; NTIS (US Sales Only); INIS.

The shift of internal friction grain boundary maximum temperature (Ke peak) versus the generation rate of point defects has been investigated in pure nickel, iron and platinum as well as in austenitic steel and Fe-^{11}B alloy. The obtained data allow to estimate the excess fluxes of both the radiation caused vacancies to grain boundaries and interstitials to dislocations. The method proposed enables to investigate point defect-impurity interaction and prognosticate the tendency of materials to radiation swelling. 8 refs.; 2 figs. (author).

26637 (INIS-mf–13545, pp. 73-80) **Cluster-loop structure influence on molybdenum radiation hardening.** Vagin, S.P. (AN Kazakhskoj SSR, Alma-Ata (Kazakhstan). Inst. Yadernoj Fiziki); Ibragimov, Sh.Sh.; Loktionov, A.A.; Reutov, V.F. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 6.* [218p.] Order Number DE93630454. Source: OSTI; NTIS (US Sales Only); INIS.

Results on defect structure study and degree of molybdenum radiation hardening irradiated by fission neutrons and medium energy alpha-particles are presented. It is shown that molybdenum irradiation by alpha-particles and neutrons leads to different degree of material hardening for the same damage level. It is established that molybdenum radiation hardening is mainly defined by radiation defect clusters visible in electron microscope whose coefficient of rigidity depends on their size. 5 refs.; 6 figs.; 2 tabs. (author).

26638 (INIS-mf–13545, pp. 81-89) **Hydrogen permeability of constructor materials during ion bombardment.** Zaluzhnyj, A.G. (Moskovskij Fiziko-Tekhnicheskij Inst., Moscow (Russian Federation)); Kopytin, V.P.; Pestretsov, S.M.; Storozhuk, O.M.; Guseva, M.I.; Gorbatov, E.A.; Naftulin, O.S. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 6.* [218p.] Order Number DE93630454. Source: OSTI; NTIS (US Sales Only); INIS.

There are described the results of the studies on the hydrogen permeability of polycrystalline nickel when hydrogen has been introduced from gas phase, from gas discharge and during ion bombardment. There are presented the data on the influence of implantation of light element ions (helium, oxygen, nitrogen and

carbon) on the hydrogen permeability of polycrystalline nickel and iron during hydrogen ion bombardment. 11 refs.; 4 figs. (author).

26639 (INIS-mf–13545, pp. 90-97) **Strain release of helium from irradiated metals and alloys.** Volkov, N.V. (Moskovskij Fiziko-Tekhnicheskij Inst., Moscow (Russian Federation)); Zaluzhnyj, A.G.; Kalin, B.A. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 6.* [218p.] Order Number DE93630454. Source: OSTI; NTIS (US Sales Only); INIS.

The strain release of helium from nickel, Kh20N45M4 and 0Kh16N15M3 alloys is described. A strong influence of the implantation method, and helium concentration on the strain release is obtained. The results are discussed in terms of an interaction of helium atom and bubble with dislocation. 7 refs.; 5 figs. (author).

26640 (INIS-mf–13545, pp. 98-105) **On the structural-phase change of transition metals implanted by interstitial element ions.** Diasamidze, Eh.M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Sukhumi (Russian Federation). Fiziko-Tekhnicheskij Inst.). AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 6.* [218p.] Order Number DE93630454. Source: OSTI; NTIS (US Sales Only); INIS.

Structural-phase changes of transition metals under implantation by B^+,C^+,N^+,O^+,F^+ ions at room temperature are investigated. The dual character of structural transition versus a kind of ions: recrystallization or amorphization - is discovered. Short-range order parameters and charge states of impurity atoms are determined. In the work a mechanism of structural changes and amorphization is formulated according to which the character of transition determines by the energetic state of impurity atom electrons subsystem into implanted excited layer. The suggested configuration model of structural changes allows to determine the direction, the kind and critical dose of the structural transition under implantation. 22 refs.; 1 fig.; 3 tabs. (author).

26641 (INIS-mf–13545, pp. 106-113) **About the role of divacancies and di-interstitials in the theory of homogeneous nucleation of radiation-induced voids in metals.** Bondarenko, A.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk (Russian Federation). Fiziko-Ehnergeticheskij Inst.); Chernov, V.M. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 6.* [218p.] Order Number DE93630454. Source: OSTI; NTIS (US Sales Only); INIS.

The system of stiff non-linear differential equations describing the kinetics of vacancy voids and interstitial dislocation loops nucleation and growth in pure metal (nickel) is solved with the high mobilities of divacancies and di-interstitials taken into account. The calculated time dependences of void nucleation rate are presented and discussed, the dependence of other values calculated, are briefly described. It is shown that the account of di-defects mobility results in significant increase of void nucleation rate. However, the rates obtained are not high enough to meet the void concentrations usually observed at highest temperatures of void formation. 13 refs.; 1 fig.; 1 tab. (author).

26642 (INIS-mf–13545, pp. 114-121) **The accumulation and annealing of radiation defects in iron-chromium alloys.** Arbuzov, V.L. (AN SSSR, Sverdlovsk (Russian Federation). Inst. Fiziki Metallov); Druzhkov, A.P.; Klotsman, S.M.; Nikolaev, A.L. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 6.* [218p.] Order Number DE93630454. Source: OSTI; NTIS (US Sales Only); INIS.

By positron annihilation measurements a vacancy build-up kinetics during electron irradiation has been investigated for Fe-15.7 at%Cr alloy and IX13-type steel in the temperature range 260-373 K. Below 273 K a linear with dose vacancy build-up kinetics is observed for alloy and steel. This indicates that there is no recombination. It is proposed that it is caused by a high concentration of traps for radiation-induced interstitial atoms (IA). The change of vacancy build-up kinetics at 323K indicates the decrease of trap concentration in the alloy with the increase of irradiation temperature. A rise of S-parameter is observed at 398-423 K indicating the onset of vacancy migration. The decay of recovery and the change of its kinetics is observed with increasing of irradiation temperature. The effect of trapped IA on the annealing kinetics is discussed. 14 refs.; 3 figs. (author).

26643 (INIS-mf–13545, pp. 129-136) **Effect of defect local piles and dislocation multiplication on radiation hardening of metals.** Kamshilin, D.V. (AN Kazakhskoj SSR, Alma-Ata (Kazakhstan). Inst. Yadernoj Fiziki); Kirsanov, V.V.; Pyatiletov, Yu.S.; Tyupkina, O.G. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 6.* [218p.] Order Number DE93630454. Source: OSTI; NTIS (US Sales Only); INIS.

Computer experiments imitating specimen strain on tension with constant deformation rate have been carried out. A formation possibility of atmosphere from defects around gliding dislocations (I) and a work of Frank-Read sources (II) have been accounted for. In result deformation curves until stresses do not exceed a critical shear stress were calculated. Influence of effects (I) and (II) was analyzed. It is determined that both by pass of dislocations over defect "atmospheres" and dislocation multiplication can cause a peak in flow stress occurrence on the deformation curves. Reasons and conditions of such peak occurrence have been studied. 12 refs.; 9 figs. (author).

26644 (INIS-mf–13545, pp. 137-146) **On kinetics of accumulation of He and H simultaneously implanted in metal.** Bakaj, A.S. (AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst.); Krasil'nikov, V.S. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 6.* [218p.] Order Number DE93630454. Source: OSTI; NTIS (US Sales Only); INIS.

It was found that simultaneous implantation of He and H in metals leads to diffusion transport of He on distances exceeding mean projected range of ions by factor of several orders. Accumulation of He and H within the bulk of metal and development of gas porosity are observed. The coefficient of He transfer in Al is greater than 2 $10^{-7}cm^2/s$. To explain experimental evidences He-atoms are assumed to migrate in the form of fast diffusing complexes with H and vacancies (He-H-V or He-H-2V). The model kinetic equations describing experimental observations are derived. 8 refs. (author).

26645 (INIS-mf–13545, pp. 147-154) **Phase structure and microhardness of zirconium irradiated with carbon, nitrogen and boron ions.** Lysova, G.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk (Russian Federation). Fiziko-Ehnergeticheskij Inst.); Gudkov, L.S.; Panin, S.D.; Chernov, V.M. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 6.* [218p.] Order Number DE93630454. Source: OSTI; NTIS (US Sales Only); INIS.

Phase composition and microhardness changes of the surface layers of zirconium were investigated after 70 keV C^+,N^+_2 and B^+ ion implantation at 10^{17}-10^{18} ion/cm^2 irradiation doses and target temperatures 30^0C and subsequent annealing. 7 refs.; 3 figs.; 2 tabs. (author).

26646 (INIS-mf–13545, pp. 155-161) **Coalescence of migrating bubbles as a mechanism of grain boundary helium porosity development in a high temperature radiation embrittlement problem.** Chkuaseli, V.F. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk (Russian Federation). Fiziko-Ehnergeticheskij Inst.). AN Ukrainskoj SSR, Kharkov

(Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 6.* [218p.] Order Number DE93630454. Source: OSTI; NTIS (US Sales Only); INIS.

The mechanism and the results of modelling of the grain boundary gas porosity development concerning the problem of high temperature radiation embrittlement of austenitic stainless steel are presented. By comparing the model results with experimental data it is shown, that the coalescence of random migrating bubbles as a bubble nucleation and growth mechanism can explain the basic features of the porosity formed on the grain boundary. It is also concluded, that the further specification of stress influence on this process is necessary. 19 refs.; 2 figs. (author).

26647 (INIS-mf–13545, pp. 171-177) **Investigation of the radiation creep bcc-materials with the help of anisotropic diffusion vacancy simulation in nuclei edge dislocations.** Borodin, V.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (Russian Federation). Inst. Atomnoj Ehnergii); Kevorkyan, Yu.P.; Kolomytkin, V.V.; Ryazanov, A.I. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 6.* [218p.] Order Number DE93630454. Source: OSTI; NTIS (US Sales Only); INIS.

Numbering modelling permitted to determine vacancy migration energy parameters in a boundary dislocation nucleus [100] <010> in α-iron and to evaluate them on the basis of polarization tensor diagonal components in nucleus dislocation. The obtained results permit to evaluate the radiation creeping rate which is determined by the efficiency of vacancy absorption by dislocations and is close to experimentally observed values. 11 refs.; 1 fig.

26648 (INIS-mf–13545, pp. 178-183) **The influence of different factors on sputtering of metallic alloys under ion bombardment.** Bondarenko, G.G. (Moskovskij Inst. Ehlektronnogo Mashinostroeniya, Moscow (Russian Federation)); Kucheryavyj, S.I.; Korzhavyj, A.P.; Sigov, D.N. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 6.* [218p.] Order Number DE93630454. Source: OSTI; NTIS (US Sales Only); INIS.

The influence of different factors - redeposition, surface oxidation and target geometry - on ion sputtering of metallic alloys is considered. It was found that considerable reduction of sputtering rate in aluminium-lithium alloys is caused by the effect of continuous reconstruction of protecting lithium layer. The results are interpreted in terms of both Gibbsian and radiation-induced segregation effects. 5 refs.; 4 figs. (author).

26649 (INIS-mf–13545, pp. 184-189) **Evolution of radiation defects attached to the annealing of nickel implanted by xenon to concentration of 0.08...1at%.** Tolstolutskaya, G.D. (AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst.); Kopanets, I.E.; Neklyudov, I.M.; Bendikov, V.I.; Rybalko, V.F. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 6.* [218p.] Order Number DE93630454. Source: OSTI; NTIS (US Sales Only); INIS.

Evolution of radiation defects in Ni <110> single crystals implanted by Xe^+ ions (energy E=600 keV) to fluences of $2{,}5x10^{15}$ - $2.5x10^{16} cm^{-2}$ during the process of isochromous post-implantation annealing at temperature range from 300 to 1300 K with step of 100 K was investigated by methods of backscattering of channeled ions, TEM, thermodesorptional spectrometry. It had been shown that part of Xe atoms in substitutional lattice location reduces with growth of irradiation dose and temperature of annealing. The annealing of irradiated samples leads to reducing of density of dislocations, to formation under $T \approx 900$ K the bubbles of high pressure, where Xe is in crystalline state, while under $T > \approx 1100$ K it leads to generation of equilibrium bubbles. 2 refs.; 6 figs. (author).

26650 (INIS-mf–13545, pp. 190-197) **Dispersion and amorphization of nickel-titanium under mechanical and radiation treatment.** Bryk, V.V. (AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst.); Malykhin, D.G.; Polyakov, Yu.I.; Sleptsov, S.N.; Chernyaeva, T.P. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 6.* [218p.] Order Number DE93630454. Source: OSTI; NTIS (US Sales Only); INIS.

Considered is the structure of nickel-titanium, dispersed and carried to amorphization by three methods: (i) plastic deformation, (ii) ion irradiation, and (iii) ion-plasma flux deposition on to a cold substrate. The structures of nickel-titanium subjected to these three types of treatment are found to be similar but not identical. Nickel-titanium deformed by 50 to 90% has a conglomerate structure, where microcrystalline particles are in the amorphous matrix. Out of the treatment types considered, it is ion irradiation that leads to the greatest degree of amorphization (appearing as a quasi-liquid state). The deposition of ion-plasma fluxes on to a cold ($20\text{-}30^0$C) substrate causes the formation of condensates with a para crystalline structure. 9 refs.; 3 figs. (author).

26651 (INIS-mf–13545, pp. 162-170) **The comparative investigation of the embrittlement of the irradiated steels and alloys with volume-centered and face-centered cubic lattices.** Neklyudov, I.M. (AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst.); Ozhigov, L.S.; Parkhomenko, A.A.; Afrikanov, I.N. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 6.* [218p.] Order Number DE93630454. Source: OSTI; NTIS (US Sales Only); INIS.

Here are given the results of the investigation of the inclination towards embrittlement of the irradiated materials with different types of the crystal lattice: the austenitic stainless steels including the steels with the micro additives of the rare-earth metals (the face-centered cubic lattice), ferrite-martensitic steels, Fe-45% Cr of the super pure alloy, of the low chromium alloy, the monocrystal of chromium (the volume-centered cubic lattice) irradiated by (e,γ)-beam up to the fluids $10^{-2}\text{-}5x10^{-1}$dpa. The investigations have shown that in the area of the low-temperature embrittlement of the irradiated materials the value of the effect is determined by the degree of hardening as a result of radiation dependable on the microstructure of the material. In the area of the high-temperature irradiation embrittlement of the face-centered cubic lattice investigated display the increase of after-irradiation ductility (plasticity) with the growth of temperature during the test. The microalloying of the rare-earth metals reduces the effect of the high temperature irradiation embrittlement of the austenitic stainless steel. 9 refs.; 6 figs. (author).

26652 (INIS-mf–13546) **Radiation materials science. V. 7.** Zelenskij, V.F. (ed.). AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. [226p.] (In Russian, English). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). Order Number DE93630373. Source: OSTI; NTIS (US Sales Only); INIS.

This volume includes the papers of the international conference on radiation materials in Alushta, Ukraine in May 1990. The main topics are: basic research in radiation damage physics, a study of the structural materials for reactor cores; irradiation effect on reactor vessel, fuel, super- and semiconductor materials; investigation damage research methods.

26653 (INIS-mf–13546, pp. 3-8) **Heat conductivity of irradiated GaP crystals and details of their thermal annealing.** Nikogosyan, S.K. (Erevanskij Fizicheskij Inst., Erevan (Armenia)); Saakyan, V.A. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 7.* [226p.] Order Number DE93630373. Source: OSTI; NTIS (US Sales Only); INIS.

The results of measurement of the heat conductivity (H) of GaP samples are presented as a function of the dose of electron radiation with E=50 MeV and after an isochronous annealing. The data analysis brought us to an inference that at irradiation there arise intrinsic radiation defects (IRD) which are identified as antisite defects of the phosphorus. A possibility of formation of complexes between these IRD is assumed at both irradiation and annealing. It is supposed that the essential difference observed between the results of n- and p-type samples annealing H is due to different mobility of the radiation effects. It is fixed that the defects in crystals with iron impurities are thermally more stable than in crystals with zinc impurities. 4 figs.; 19 refs. (author).

26654 (INIS-mf–13546, pp. 9-18) **Magnetic state of $Fe_{69.5}Ni_{30.5}$ alloy with bcc-fcc transitions induced by ion irradiation.** Ovchinnikov, V.V. (Institut Ehlektrofiziki, Ural'skoe otdelenie RAN, Sverdlovsk (Russian Federation)); Kogan, Yu.D.; Gavrilov, N.V.; Shtol'ts, A.K. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 7.* [226p.] Order Number DE93630373. Source: OSTI; NTIS (US Sales Only); INIS.

The bcc-fcc transitions in Fe+30,5 at.% Ni alloy have been investigated by the ion bombardment. By nuclear γ-resonance method it has been found that a wide spectrum of various magnetic states of fcc-phase can be obtained as a fluence, an amplitude, a pulse rate under irradiation in pulse-repetition regime. Some of these states are similar to those appearing at high pressure in some tens kilo bars. The densities of P(H)-probabilities of effective-magnetic field distribution on ^{57}Fe nuclei which are representative of the magnetic-moment z-projection distribution of Fe and Ni atoms on the crystal lattice sites have been calculated. 8 refs.; 3 figs. (author).

26655 (INIS-mf–13546, pp. 19-22) **Studies of radiation effect on shape memory alloys.** Sinel'nikov, L.P. (Nauchno-Issledovatel'skij i Konstruktorskij Inst. Ehnergotekhniki, Moscow (Russian Federation)); Loguntsev, E.N.; Kozlov, A.V.; Kovalev, I.N.; Abramov, V.Ya.; Litvin, D.F.; Ionajtis, R.R. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 7.* [226p.] Order Number DE93630373. Source: OSTI; NTIS (US Sales Only); INIS.

The investigation of in-core radiation influence on shape memory alloys of Mn-Cu and Fe-Mn types is carried out. The alloys 80% Mn-20% Cu, 75% Mn-22% Cu-3% Cr and Fe-31% Mn-5% Si were irradiated in first circuit water of a research reactor at the temperature of 60^0C and up to the fluence of $1x10^{19}$, $5x10^{19}$ and $1x10^{20}$n/cm^2 (E$\geq$0,5 MeV). It is shown that the shape reduction takes place with heating for all the samples except Fe-31%Mn-5%Si alloy samples, irradiated up to the fluence of $1x10^{20}$n/cm^2. The shape reduction degree is noted to decrease with fluence increase. 2 refs.; 4 figs.

26656 (INIS-mf–13546, pp. 23-26) **Effect of electron beam treatment on diffusion of copper into a titanium base layer.** Barinov, V.I. (AN Belorusskoj SSR, Minsk (Belarus). Inst. Yadernoj Ehnergetiki); Vashchenko, S.V.; Fedyushin, E.E. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 7.* [226p.] Order Number DE93630373. Source: OSTI; NTIS (US Sales Only); INIS.

The results are presented of the investigation into the thermo radiation diffusion of copper from a galvanic coating into the depths of a titanium base layer made of two-phase α+β-alloys (BT6 and BT23 types) under the effect of a 15-20 KeV electron beam both in the continuous and pulse modes of treatment with a frequency of 5 Hz. It is found the effect of electron current results in the change in the surface physical state, i.e. the change in the energy of an atomic boundary layer, formation of vacancies and dislocations lowering the activation energy of diffusion processes. The results obtained are explained from the position of irreversible processes with allowance for the influence and super-imposing of elementary fluxes. 7 refs.

26657 (INIS-mf–13546, pp. 27-37) **Phase transitions in the transient metal oxides under electron irradiation.** Stepanov, V.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk (Russian Federation). Fiziko-Ehnergeticheskij Inst.); Chernov, V.M.; Kryukova, L.M. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 7.* [226p.] Order Number DE93630373. Source: OSTI; NTIS (US Sales Only); INIS.

The kinetics of V_2O_5 and MoO_3 monocrystal structural changes has been investigated under electron irradiation with various energies (80-1000 keV). Irradiation with various energies and/or in different crystallographic directions results in formation of various phases. The oxygen vacancies concentration-dependent phases diagram has been built under different irradiation conditions with allowance for their dipole-dipole interaction. 7 refs.; 5 figs.

26658 (INIS-mf–13546, pp. 46-53) **Radiative effects and properties of refractory metals with the bcc and hcp.** Zakharova, M.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk (Russian Federation). Fiziko-Ehnergeticheskij Inst.); Artemov, N.A. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 7.* [226p.] Order Number DE93630373. Source: OSTI; NTIS (US Sales Only); INIS.

Results of swelling, temperature dependence of electric resistance, internal friction, elasticity modules of monocrystal samples of molybdenum, tungsten, vanadium, niobium (BCC- <100>, <110>, <111>) and rhenium (HCP-<0001>) after neutron irradiation up to the fluence of $1,14x10^{26}$ n/m^2 (E>0.1 MeV) at the temperature of 460^0C and isochronous annealing up to 0.7 T_m are presented. Some features of behaviour of metals with the BCC and HCP lattices, metals of the V and VI groups of the periodic system and the role of interstitials impurities in relaxation processes development and in changing their physical and mechanical properties under irradiation are discussed. 3 refs.; 6 figs.; 1 tab.

26659 (INIS-mf–13546, pp. 54-58) **Surface damage by emission of target atoms under ion bombardment.** Nikiforov, V.I. (AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst.); Pavlenko, V.I.; Sleptsov, S.N.; Khirnov, I.V. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 7.* [226p.] Order Number DE93630373. Source: OSTI; NTIS (US Sales Only); INIS.

Computer simulation was used to investigate the evolution of the spot emitting scattered particles on amorphous materials TaC and Ni irradiated by a Ne^+ ion beams with an energy ranging from 100 eV to 10 keV and angle of incidence $\alpha=0^0$. It is shown that the growth rate of the spot falls and the entirely ceases with the incident ion energy increase above E_{ic} (E_{ic} is the critical energy). This is explained by predominant incident ion energy dissipation inwards the target material rather than in the direction along the subsurface layer. 2 refs.; 4 figs.

26660 (INIS-mf–13546, pp. 59-63) **Sputtering of graphite, niobium and niobium carbide by neutron bombardment. Computer simulation.** Kamenev, A.S. (AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst.); Nikiforov, V.I.; Pavlenko, V.I.; Khirnov, V.I. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 7.* [226p.] Order Number DE93630373. Source: OSTI; NTIS (US Sales Only); INIS.

Sputtering yields of graphite, niobium and niobium carbide by neutron irradiation were obtained by computer simulation. It is shown that the niobium sputtering yield in niobium carbide is by

factors 4 to 10 less than that in pure niobium (under the same initial conditions). It is also found that niobium carbide irradiation by fast neutrons may give rise to sputtering (≈40%) carbon atoms with a high average energy E≈>100 eV. 8 refs.; 2 figs. (author).

26661 (INIS-mf–13546, pp. 64-77) **Hydrogen permeation in stainless steel type 12 Cr18NI10T under neutron -and gamma - irradiation conditions.** Gerasin, V.Ya. (Nauchno-Proizvodstvennoe ob"edinenie "Luch", Semipalatinsk (Russian Federation)); Eremeev, V.S.; Basov, A.V.; Kenzhin, E.A. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 7.* [226p.] Order Number DE93630373. Source: OSTI; NTIS (US Sales Only); INIS.

Hydrogen permeation in steel type 12Kh18N10T in reactor-radiation with neutron - and gamma-quantum density flux $3x10^{10}$nxcm^{-2}xc^{-1} and 10^{9}cm^{-2}xc^{-1} correspondently with summarized radiation dose 5x10^{1}'5cm^{-2} in temperature range 673-973 K, with hydrogen pressure 0,3 MPa is studied. Description of technique and test plant is given and the achieved results are discussed here. The remarkable unreversible increase of hydrogen permeation through steel and some reduction of energy activation under reactor irradiation was found. 7 refs.; 4 figs. (author).

26662 (INIS-mf–13546, pp. 78-85) **The influence of implanted helium on nickel radiation resistance under conditions simulating plasma flux disruption in nuclear fusion reactor.** Kalin, B.A. (Moskovskij Inzhenerno-Fizicheskij Inst., Moscow (Russian Federation)); Pol'skij, V.I.; Yakushin, V.L.; Tserevitinov, S.S.; Vasil'ev, V.I.; Markin, A.V. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 7.* [226p.] Order Number DE93630373. Source: OSTI; NTIS (US Sales Only); INIS.

The paper presents the results on Nuclear Fusion Reactor (NFR) first wall materials radiation erosion caused by a series of impulses to simulate plasma disruption and by 40 keV helium ion fluxes with doses $2x10^{21}m^{-2}$ and $1x10^{22}m^{-2}$. The series in question consisted of 2-10 impulses of high-temperature D-plasma fluxes (IHTPF) with incident power density up to $2x10^{10}W/m^2$. Prior exposure to IHTPF has been found to come a substantial increase of the material resistance to erosion under the action of subsequent ion irradiation. Exposure to IHTPF at the late stages of ion bombardment results in a sharp change of material (material surface) structure with new blisters appearing and breaking with open porosity and cracking. At the high doses of ion bombardment ($\Phi>\Phi_{th}$) an almost complete helium release is observed while at lower doses ($\Phi<\Phi_{th}$) only about 50%. 7 refs.; 3 figs.; 2 tabs.

26663 (INIS-mf–13546, pp. 92-97) **The effect of noble gas implantation of corrosion of metals and alloys.** Zelenskij, V.F. (AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst.); Petel'guzov, I.A.; Pekova, L.P.; Lifshits, E.V.; Chernukha, V.P.; Rodak, A.G. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 7.* [226p.] Order Number DE93630373. Source: OSTI; NTIS (US Sales Only); INIS.

Corrosion behaviour of zirconium, O4KH16N15M3B steel, copper, Zr-1%Nb and Zr-2.5%Nb alloys is studied under irradiation with helium and argon ions. After irradiation with He or Ar in the dose range between $5x10^{5}$ and $5x10^{17}$ ion/cm^2, all the samples, irrespectively of their mechanism of oxidation (Zr,Cu) showed an improved corrosion resistance. This improvement value depended on the species of the particles and the dose. Kinetics of ion thermodesorption from irradiated materials is also investigated. On the basis of the available literary data and the present experimental results, possible mechanisms leading to the improved corrosion resistance of the materials are discussed. 9 refs.; 7 figs. (author).

26664 (INIS-mf–13546, pp. 132-138) **Some characteristics properties of structure of stainless steel pipe blanks produced by vacuum centrifugal casting for nuclear power.** Zelenskij, V.F. (AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst.); Neklyudov, I.M.; Chernyj, B.P. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 7.* [226p.] Order Number DE93630373. Source: OSTI; NTIS (US Sales Only); INIS.

Results of studies macro- and microstructures of centrifugal castings and distributions of inclusions and alloying elements and impurities are presented. It was established that distribution of components of steels in castings is uniform. The macro structure is band and the microstructure is dendritic. Principal feature of centrifugal castings is redistribution of inclusions, main part of casting being free from conclusions. 1 refs.; 4 figs.; 3 tabs. (author).

26665 (INIS-mf–13546, pp. 139-145) **Microstructural evolutions in ferritic-martensitic Kh12MVFR-type steel during irradiation and the effect of these evolutions on its radiation resistance capability.** Ioltukhovskij, A.G. (Nauchno-Proizvodstvennoe Ob"edinenie Ehnergiya, Moscow (Russian Federation)); Leont'eva-Smirnova, M.V.; Zhukov, A.G.; Zelenov, V.I.; Barsanov, V.I.; Kozlov, A.V.; Kolbenkov, S.A. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 7.* [226p.] Order Number DE93630373. Source: OSTI; NTIS (US Sales Only); INIS.

Microstructural evolutions in ferritic-martensitic Kh12MBFP-type steel during irradiation and the effect of these evolutions on its radiations resistance capability are described. Microstructural evolutions in 12% Cr Kh12MBFP-type steel during neutron irradiation (E>0.1 MeV) to the fluence $2x2x10^{27}n/m^2$ under 385-460^{0}C are observed both in δ-ferrite and sorbite zones. Significant interaction of the irradiation induced point defects with impurity atoms and high density dislocation pile up results in the evolution of the dislocation structure in sorbite, precipitation of $Me_{23}O_6$ and MeC as well as precipitation of globular χ-phase in δ-ferrite. Porosity generation and related swelling are not observed. Significant accumulation of the irradiation induced defects causing embrittlement does not occur. 5 refs.; 6 figs.; 1 tab. (author).

26666 (INIS-mf–13546, pp. 174-180) **Employment of ferritic steels for fbr fuel element cladding in high temperature conditions.** Dolmatov, P.S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk (Russian Federation). Fiziko-Ehnergeticheskij Inst.); Popov, V.V.; Khmelevskij, M.Ya. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 7.* [226p.] Order Number DE93630373. Source: OSTI; NTIS (US Sales Only); INIS.

Fuel and cladding interaction in fuel elements result in local corrosion pits on the inner surface of ferritic cladding. The results of calculations of stresses in cladding near by corrosion pit were obtained with finite element method application and shown in this paper. Corrosion pits lead to a great concentration of stresses, therefore in the consideration of a cladding lifetime it is necessary to use special calculations instead of thickness decreasing approach. 2 refs.; 5 figs.; 2 tabs. (author).

26667 (INIS-mf–13546, pp. 111-116) **Influence of neutron irradiation and self-irradiation on crystal structure of Pu-Al and Pu-Ga δ-phase alloys.** Inozemtsev, V.V. (Vsesoyuznyj Nauchno-Issledovatel'skij Inst. Neorganicheskikh Materialov, Moscow (Russian Federation)); Panteleev, L.D.; Chebotarev, N.T. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 7.* [226p.] Order Number DE93630373. Source: OSTI; NTIS (US Sales Only); INIS.

The influence was studied effected by neutron irradiation (NI) to fluences of $1.5x10^{15}$-$3x10^{17}$ thermal n/cm^2 and prolonged self-irradiation (SI) at temperatures ≈ 70^{0}C on the crystal structure of Pu-Ga and Pu-Al δ-phase alloys. It is shown that the metastable δ-phase of all the alloys indicated is resistant to NI. It is established that the irradiation of the alloys increases the lattice parameters

depending on the Ga, Al concentration in the lattice of the δ-phase and leads to the anisotropic broadening of X-ray lines. NI and SI effected changes of the fine X-ray structure are mainly related to the realization the covalent constituent of the interatomic bond of atoms in the δ-crystal lattice. This realization becomes feasible due to the accumulation and evolution of irradiation induced defects that provide for a partial relaxation of internal stresses. 5 refs.; 4 figs. (author).

26668 (INIS-mf–13546, pp. 146-152) **In-reactor creep of steels and alloys with various Fe-Cr-Ni bases in the BN-350 commercial fast reactor.** Budylkin, N.I. (Vsesoyuznyj Nauchno-Issledovatel'skij Inst. Neorganicheskikh Materialov, Moscow (Russian Federation)); Mironova, E.G.; Vorob'ev, A.N.; Dmitriev, V.D. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 7.* [226p.] Order Number DE93630373. Source: OSTI; NTIS (US Sales Only); INIS.

The results of the materials in-reactor creep investigations performed on tube specimens are presented. The dependences of creep parameters on the level of specified stresses of 0-300 MPa and doses of 20-60 dpa have been obtained. It has been established that separate alloying of B,C and joint alloying of B,Ti,Al result in considerable reduction of the in-reactor creep strain. The 20% cold working of tubes differently affects the change in the creep parameters at 480^{0}C. 5 refs.; 5 figs. (author).

26669 (INIS-mf–13546, pp. 153-158) **Estimation of the effect of operation on deformation of BN-600 fuel assembly tubes and fuel pin cladding fabricated of austenitic Cr/Ni steel.** Larin, E.P. (Nauchno-Proizvodstvennoe Ob"edinenie Ehnergiya, Moscow (Russian Federation)); Ioltukhovskij, A.G.; Andrianov, A.N.; Shejnkman, A.G.; Kireev, M.G. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 7.* [226p.] Order Number DE93630373. Source: OSTI; NTIS (US Sales Only); INIS.

The formulae given in this paper describe relationship between structural elements deformations and operational factors (i.e. temperature, damage doze). Measurement results obtained following irradiation of fuel cladding (type Kh16N15M3B steel, austenitized) and fuel assembly tubes (type O8Kh16N11M3 mechanically and thermally treated) are in good agreement with the design values. Based on these formulae models to assess temperature of fuel claddings and fuel assembly tubes during irradiation have been developed. In particular it is proposed to use the radiation of elongated cladding to maximum increased of its diameter. These models allow to assess temperature deviations in the core and inside separate fuel assemblies. 4 refs.; 6 figs. (author).

26670 (INIS-mf–13546, pp. 159-166) **Investigation of kinetics of nucleation and propagation crack in 0Kh16Ni15M3B austenite stainless steel specimens after annealing and irradiation.** Dorovskoj, V.M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (Russian Federation). Inst. Atomnoj Ehnergii); Elesin, L.A. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 7.* [226p.] Order Number DE93630373. Source: OSTI; NTIS (US Sales Only); INIS.

Experimental results of microcrack nucleation process and propagation kinetics of austenite stainless steel after annealing and neutron irradiation are presented. They were obtained by method in-situ electron microscope. A pseudostereomethod was applied to estimate qualitatively stress field in material region located around the crack tip. It was found that around a crack there were regions with tensile and compressing stresses. Radiation defects in a neutron-irradiation material structure were absent in local regions with prevailing tensile stress. 6 refs.; 8 figs. (author).

26671 (INIS-mf–13546, pp. 167-173) **Fracture mechanics behaviour of neutron irradiated austenitic steel 0Kh16N15M3B.** Likhachev, Yu.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk (Russian Federation). Fiziko-Ehnergeticheskij Inst.); Troyanov, V.M.; Gibadulin, R.Kh.; Popov, V.V.; Ermolaev, S.N. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 7.* [226p.] Order Number DE93630373. Source: OSTI; NTIS (US Sales Only); INIS.

The neutron irradiation of structural materials results in decreasing of fracture toughness. In this article a special experiment for definition of fracture toughness K_c and J_c on the irradiated specimens is described. Specimens were made from austenitic steel 0Cr16Ni15Mo3Nb and irradiated in reactor BN-600 to a maximum flux about $2x10^{23}$n/cm^2 by a temperature 450^{0}C. Specimens were tested in tensile condition at the 450^{0}C. A critical coefficient K_c was obtained with using a 5 percent offset technique. For the ductile materials a value of J_c was obtained with using a Rice's correlation. 4 refs.; 4 figs.; 2 tabs. (author).

26672 (INIS-mf–13546, pp. 181-188) **Tensile properties of high nickel-base alloys Kh18N40M3B and nimonic PE-16 irradiated to neutron damage level of 60 dpa.** Vorob'ev, A.N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk (Russian Federation). Fiziko-Ehnergeticheskij Inst.); Ermolaev, S.N.; Vakhtin, A.G.; Budylkin, N.I.; Mironova, E.G. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 7.* [226p.] Order Number DE93630373. Source: OSTI; NTIS (US Sales Only); INIS.

Tensile properties of Kh18N40M3B alloy with and without boron, titanium and aluminium additions and of Nimonic PE-16 alloy were measured after neutron irradiation at 500+-20^{0}C up to damage level of 60 dpa (TRN). The strength and ductility of these alloys were determined as a function of test temperature ranging from 300 to 750^{0}C. The severe embrittlement was found for alloys doped by Ti and Al. All alloys investigated demonstrate high temperature irradiation embrittlement at test temperature above 550^{0}C. 5 refs.; 4 figs.; 2 tabs. (author).

26673 (INIS-mf–13546, pp. 106-110) **Hydrogen permeation in austenite steels under neutron irradiation.** Polosukhin, B.G. (Nauchno-Issledovatel'skij i Konstruktorskij Inst. Ehnergotekhniki, Moscow (Russian Federation)); Zyryanov, A.P.; Baskakov, E.P. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 7.* [226p.] Order Number DE93630373. Source: OSTI; NTIS (US Sales Only); INIS.

Influence of fast neutrons from reactor on Kh18N10T and Kh16N11M3T austenitic steels penetrability for hydrogen was studied. These steels are candidates as construction materials for thermonuclear reactors and such parameters of hydrogen transfer as penetrability, diffusion, solubility were investigated in them during and after irradiation in reactor. 3 refs.; 3 figs. (author).

26674 (INIS-mf–13546, pp. 117-124) **Dispersion hardening and radiation damage in austenitic stainless steels.** Sagaradze, V.V. (AN SSSR, Sverdlovsk (Russian Federation). Inst. Fiziki Metallov); Nalesnik, V.M.; Lapin, S.S. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 7.* [226p.] Order Number DE93630373. Source: OSTI; NTIS (US Sales Only); INIS.

Radiation swelling and structure of austenitic steels Kh16Ni15M3 and Kh12Ni30M3 doped by Ti,Al,Si was studied after irradiation in BN-600 reactor up to the damaging dose 60 dpa at 480-500^{0}C. It was shown that the swelling after irradiation was considerably less in Kh16 steel with 1%Ti comparing with steels without Ti and with 0.3 mass%Ti. 6 refs.; 1 fig.; 2 tabs. (author).

26675 (INIS-mf–13546, pp. 125-131) **The effect of the tensile stress on the swelling and microstructure of the stainless steels irradiated to high neutron fluence.** Porollo, S.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR,

Obninsk (Russian Federation). Fiziko-Ehnergeticheskij Inst.); Dmitriev, V.D.; Vorob'ev, A.N.; Budylkin, N.I.; Mironova, E.G. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 7.* [226p.] Order Number DE93630373. Source: OSTI; NTIS (US Sales Only); INIS.

The void swelling and microstructure of the 0Kh16N15M3B and 0Kh16N15M3BP austenitic steels after irradiation in BN-350 reactor to displacement doze of 60 dpa at 480^{0}C versus the applied stress have been studied. The swelling of those steels was found are linear with the biaxial tensile stress changing over the range 0/196 MPa. Swelling modulus, therewith was equal to $5x10^{-3}MPa^{-1}$ and $9.2/15.8x10^{-3}MPa^{-1}$ for the 0Kh16N15M3B and OKh16N15M3BP steels respectively. The stress effects the void number density increase without any significant changes of the void size. 2 refs.; 5 figs.; 1 tab. (author).

26676 (INIS-mf–13546, pp. 189-195) **Void swelling of hexagonal wrappers of BN-600 sub-assemblies.** Vakhtin, A.G. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk (Russian Federation). Fiziko-Ehnergeticheskij Inst.); Porollo, S.I.; Dmitriev, V.D.; Aleksandrov, Yu.I. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 7.* [226p.] Order Number DE93630373. Source: OSTI; NTIS (US Sales Only); INIS.

The void swelling of the hexagonal wrappers fabricated from O8Kh16N11M3 (thermo mechanically) O8Kh16N11M3T-20% cold working (CW) and O7Kh15N13M2T (20% CW) steels and irradiated up damage level of 70 dpa (TRN) was studied. For O8Kh16N11M3 steel void swelling at wrapper corners was found to be 3-4 times larger then at wrapper flats. For cold-worked steels the adverse effect has been observed. This is due to the difference of steel microstructure at flats and corners of the wrappers. 2 refs.; 5 figs.; 2 tabs. (author).

26677 (INIS-mf–13547) **Radiation materials science. V. 8.** Zelenskij, V.F. (ed.). AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. [232p.] (In Russian, English). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). Order Number DE93630368. Source: OSTI; NTIS (US Sales Only); INIS.

This volume includes the papers of the international conference on radiation materials in Alushta, Ukraine in May 1990. The main topics are: basic research in radiation damage physics, a study of the structural materials for reactor cores; irradiation effect on reactor vessel, fuel, super- and semiconductor materials; investigation damage research methods.

26678 (INIS-mf–13547, pp. 63-67) **Investigation of quench induced faults in the hcp crystalline structure of zirconium alloys.** Sharov, B.N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (Russian Federation). Inst. Teoreticheskoj i Ehksperimental'noj Fiziki); Chizhikov, Yu.B. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 8.* [232p.] Order Number DE93630368. Source: OSTI; NTIS (US Sales Only); INIS.

A simple geometrical model of hcp is used to prove by means of X-ray diffraction the existence of stacking faults in the hcp structure of zirconium alloys Zr+1%Nb and Zr+2.5%Nb. These faults are found to be thermally-stable. Its effect on the irradiation-induced faults evolution is suggested. 7 figs. (author).

26679 (INIS-mf–13547, pp. 41-46) **Irradiation effect on corrosion cracking of WWER reactors fuel element claddings ion iodium and cesium iodide medium.** Stupina, L.N. (Nauchno-Issledovatel'skij Inst. Atomnykh Reaktorov, Dimitrovgrad (Russian Federation)); Shamardin, V.K.; Kobylyanskij, G.P. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 8.* [232p.] Order Number DE93630368. Source: OSTI; NTIS (US Sales Only); INIS.

Strength of WWER reactors fuel element simulators in an aggressive fission products medium (iodium and cesium iodide) at temperature 380^{0}C was investigated. Experimental results of reactor irradiation effect on stress corrosion cracking (SCC) of the Zr-1%Nb alloy cladding tubes were presented. Identity of destruction mechanisms with iodium and cesium iodide was shown. Influence of fast neutron fluence to $5x10^{25}m^{-2}$ on destruction stress under SCC conditions was established. 4 refs.; 4 figs. (author).

26680 (INIS-mf–13547, pp. 3-6) **Creep of irradiated austenitic Kh16N15M3B steels at temperatures 300-700^{0}C.** Rogozyanov, A.Ya. (Nauchno-Issledovatel'skij Inst. Atomnykh Reaktorov, Dimitrovgrad (Russian Federation)); Gorbatov, V.K.; Samsonov, B.V. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 8.* [232p.] Order Number DE93630368. Source: OSTI; NTIS (US Sales Only); INIS.

Dependence of the fixed creep rate of irradiated austenitic Kh16N15M3B steels upon stress σ and temperature T was investigated. The tests were conducted in the RBT-6 reactor with the fast neutron flux density $\phi=3x10^{17}m^{-2}s^{-1}$ (E>0.1 MeV) and partially (with stresses below the yield limit σ_T) in the SM-2 reactor with $\phi=2x10^{18}m^{-2}xs^{-1}$ and T=300-700^{0}C. The fixed creep rate of alloys under investigation can be described by the following relationship: $\varepsilon=(B_o+Bxk)\sigma+A\sigma^n xexp(-U/8,31T)$, where A,B,$B_0$,n are factors, U is the energy of activation, K is the rate of radiation damage. Factor A depends on ϕ, and also on the neutron fluence at T=300-500^{0}C. The dependence describes all the mass of data according to different steel modifications with one and the same basis within a wide range of stresses and temperatures. 4 refs.; 2 figs.; 1 tab. (author).

26681 (INIS-mf–13547, pp. 7-14) **A study of the phase structure of radiation-resistant steel.** Neklyudov, I.M. (AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst.); Chernyj, B.P.; Vanzha, A.F.; Rabinovich, A.V.; Milova, I.M.; Zaslavskij, Yu.B. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 8.* [232p.] Order Number DE93630368. Source: OSTI; NTIS (US Sales Only); INIS.

Results from studies of microstructure and phase structure of the radiation-resistant steel O6Kh16N15M2T with micro additions of scandium are presented. It is shown that the quantity and composition of the precipitated phases are determined by the content of scandium, phosphorus, interstitial oxygen and nitrogen. Influence of homogenizing annealing on the phase, structure and dissolution kinetics of the precipitated phases is studied. The ultimate scandium solubility in the steel O6Kh16N15M2T at 1270^{0}C is 0.06 wt.%. 4 figs.; 2 tabs. (author).

26682 (INIS-mf–13547, pp. 22-27) **Changes in zirconium microstructure and properties under LOCA simulation conditions.** Mojnov, A.S. (Vsesoyuznyj Nauchno-Issledovatel'skij Inst. Neorganicheskikh Materialov, Moscow (Russian Federation)); Nikulina, A.V.; Bibilashvili, Yu.L.; Glazkov, A.G.; Sidorenko, V.I. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 8.* [232p.] Order Number DE93630368. Source: OSTI; NTIS (US Sales Only); INIS.

The influence of oxidation at 1000-1200^{0}C on changes in microstructure and properties of Zr1%Nb clads was investigated. The results are presented it is shown that with the extent of oxidation increased the strength properties of clads are drastically reduced. The data are given on the cladding material saturation with oxygen and hydrogen. 7 refs.; 3 figs. (author).

26683 (INIS-mf–13547, pp. 28-34) **Strength of technological channel tubes.** Vasnin, A.M. (Nauchno-Issledovatel'skij i Konstruktorskij Inst. Ehnergotekhniki, Moscow (Russian Federation)); Rivkin,

E.Yu.; Rodchenkov, B.S.; Sinel'nikov, L.P. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 8.* [232p.] Order Number DE93630368. Source: OSTI; NTIS (US Sales Only); INIS.

A prolonged strength of materials used in technological channels of RBMK reactors at 300-350^{0}C temperature range was determined. It was shown that the prolonged strength of zirconium alloys increases after neutron irradiation. Critical lengths of cracks for normal conditions of operation are calculated. 5 refs.; 5 figs.; 2 tabs. (author).

26684 (INIS-mf–13547, pp. 35-40) **Radiation growth of zirconium alloys.** Abramov, V.Ya. (Nauchno-Issledovatel'skij i Konstruktorskij Inst. Ehnergotekhniki, Moscow (Russian Federation)); Golovachev, M.G.; Kalachikov, V.E.; Rodchenkov, B.S. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Aiushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 8.* [232p.] Order Number DE93630368. Source: OSTI; NTIS (US Sales Only); INIS.

Results of radiation swelling investigations in Zr-Sn-Nb-Fe alloy of high strength as well as in Zr-2.5Nb alloy which is characterized by a high corrosion stability, resistance to creeping and low hydrogen absorption are presented. 3 refs.; 3 figs.; 1 tab. (author).

26685 (INIS-mf–13547, pp. 47-54) **The structural-phenomenological description of plastic anisotropy of H-1 and H-2.5 alloys, subjected to reactors irradiation.** Yamshchikov, N.V. (Moskovskij Inzhenerno-Fizicheskij Inst., Moscow (Russian Federation)); Prasolov, P.F.; Lebedinskij, K.B. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 8.* [232p.] Order Number DE93630368. Source: OSTI; NTIS (US Sales Only); INIS.

The structural-phenomenological model of anisotropic single hpc textured polycrystals is described. The formulation of the present model is assumed that the polycrystal is continuous three-dimensional collection of transversal crystallites, the plastic properties which Hill's yield criteria are described. This model is allowed to determine six parameters in the Hill's yield criteria for ortho tropic materials based on only of uniaxial tension test in three directions and crystallographic texture. Yield surfaces of zircaloy alloys at 293 K and 623 K, subjected to irradiation in the reactor with total exposition dose 10^{20}n/cm^2 are determined. Strongly influence of irradiation on the plastic behaviour of H-1 and H-2,5 alloys is observed. 2 refs.; 3 figs.; 2 tables. (author).

26686 (INIS-mf–13547, pp. 55-62) **Anisotropy of irradiation strengthening of textured zirconium alloys H-1 and H-2.5.** Prasolov, P.F. (Moskovskij Inzhenerno-Fizicheskij Inst., Moscow (Russian Federation)); Lebedinskij, K.B.; Platonov, P.A.; Viktorov, V.F. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 8.* [232p.] Order Number DE93630368. Source: OSTI; NTIS (US Sales Only); INIS.

Strength and plastic alloy properties before and after in-pile irradiation up to integral dose of 10^{20}n/cm^2 were obtained on the samples machined from the plate of master alloys H-1 and H-2.5 in the main ortho tropic directions. Uniaxial tension-compression tests were done under T-293,623 K and with the strain rate of about $10^{-3}c^{-1}$. Irradiation strengthening anisotropy is shown to depend on the alloy composition. Irradiation is proved to decrease alloy anisotropy. Quality evaluation of the alloy anisotropy is given. The method of predicting strength properties of irradiated materials is presented. 5 refs.; 3 figs.; 3 tabs. (author).

26687 (INIS-mf–13547, pp. 98-102) **Physical nature of strengthening of chromium under irradiation.** Trefilov, V.I. (AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst.); Zelenskij, V.F.; Neklyudov, I.M. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 8.* [232p.] Order Number DE93630368. Source: OSTI; NTIS (US Sales Only); INIS.

The results of investigation of radiation strengthening and embrittlement of chromium and its small-doped alloys in wide interval of radiation doses ($5x10^{23}$ ... $2x10^{27}$n/m^2) and temperatures (20...800^{0}C) are presented. It is established that there is a strong dependence between radiation strengthening chromium and the of interstitial impurities (N,C,O) in it, also between radiation embrittlement and swelling. It is shown that micro doping chromium by high-active oxide-, nitride- and carbide-forming elements with a large atom radius as as Sc, Nb prevents impurite segregation and as a consequence, reduces the radiation swelling, strengthening and embrittlement. 5 refs.; 2 figs. (author).

26688 (INIS-mf–13547, pp. 15-21) **Quality improvement of radiation-resistant steels by filtration.** Zelenskij, V.I. (AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst.); Neklyudov, I.M.; Chernyj, B.P. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 8.* [232p.] Order Number DE93630368. Source: OSTI; NTIS (US Sales Only); INIS.

Results from laboratory studies of the influence of metal deoxidation, material and design properties of ceramic magnesia and aluminia filters on stainless steel refining are presented. It is shown that the use of ceramic filters allows one to decrease the number of coarse non-metal inclusions in castings. 11 refs.; 2 figs.; 1 tab. (author).

26689 (INIS-mf–13547, pp. 125-131) **A steel with a high neutron absorption cross section for nuclear reactor protection control systems.** Zelenskij, V.F. (AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst.); Neklyudov, I.M.; Chernyj, B.P.; Nevorotin, V.K.; Fedorov, V.A. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 8.* [232p.] Order Number DE93630368. Source: OSTI; NTIS (US Sales Only); INIS.

A gadolinium-alloyed steel O3Kh16N15M3B has been studied. Alloying with 0.02-1.0% gadolinium did not essentially affect the amount of non-metal inclusions in the steel. At test temperatures between 20 and 570^{0}C, the stress-strain properties of the steel with 0.02-0.5% of gadolinium correspond to the properties of the primary steel. X-ray analysis has shown a 0.05-0.11 wt% ultimate Gd solubility in the steel. The steel with 0.02-1.0% gadolinium did not develop the intergranular corrosion. The indices of weldability of both the primary steel and the steel alloed with gadolinium remain at the same level. 3 refs.; 7 figs.; 1 tab. (author).

26690 (INIS-mf–13547, pp. 144-150) **The mechanism and mathematical model of nodule (spot) corrosion of zirconium alloys.** Perekhozhev, V.I. (Nauchno-Issledovatel'skij i Konstruktorskij Inst. Ehnergotekhniki, Moscow (Russian Federation)); Surnin, A.G.; Mizyukanov, A.G. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 8.* [232p.] Order Number DE93630368. Source: OSTI; NTIS (US Sales Only); INIS.

It is suggested that nodule corrosion on fuel claddings, process channel surfaces a fuel assembly surfaces is induced by a short circuit of an oxide film by intermetallic Zr compounds with impurities or doped-components or by their oxides with deposition of corrosion products of the NPP first circuits. In terms of the electrochemical corrosion model the equivalent electrical diagrams for nodule corrosion process in the stages of pre- and post-transition oxidation were suggested. The expressions defining nodule corrosion kinetics are obtained. The results of computer calculations of nodule corrosion as a function of operation conditions a running time are adduced. 4 refs.; 4 figs. (author).

26691 (INIS-mf–13547, pp. 151-157) **Second phase inclusion effect on the mechanism of irradiation nodula corrosion**

of the unswelling alloys. Karasev, V.S. (AN Ukrainskoj SSR, Kiev (Ukraine). Inst. Yadernykh Issledovanij); Kovyrshin, V.G.; Chirko, L.I.; Shinakov, A.A.; Tutnov, A.A.; Sergeeva, L.V. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 8.* [232p.] Order Number DE93630368. Source: OSTI; NTIS (US Sales Only); INIS.

Radiation-induced nodular corrosion mechanism based on the metallographic and X-rays investigations of corrosion damage boiling water reactor canal tubes was suggested. According to this mechanism the swelling of the second phase inclusions (carbides, intermetallic particles) in the Zr-alloys unswelling matrix lead to local strains which accelerates corrosion under irradiation. Correlations between the sizes of second phase inclusion and plastic deformated zone necessary for the nodular formation were calculated. 14 refs.; 3 figs. (author).

26692 (INIS-mf–13547, pp. 158-164) **Study of crack initiation and propagation mechanism on SCC of Zr-1%Nb VVER fuels.** Novikov, V.V. (Vsesoyuznyj Nauchno-Issledovatel'skij Inst. Neorganicheskikh Materialov, Moscow (Russian Federation)); Sokurskij, Yu.M.; Bibilashvili, Yu.K. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 8.* [232p.] Order Number DE93630368. Source: OSTI; NTIS (US Sales Only); INIS.

The paper presents the results of investigations into crack initiation on stress corrosion cracking (SCC) of Zr-1% Nb claddings. Iodine distribution has been studied at inner clad surfaces, points of crack initiation and crack surface. Intergranular iodine diffusion has been estimated. Consideration has been given to the mechanism of SCC. 4 refs.; 8 figs. (author).

26693 (INIS-mf–13547, pp. 112-117) **Structure and properties of the aluminium alloy SAW-1 after long-term reactor irradiation.** Karasev, V.S. (AN Ukrainskoj SSR, Kiev (Ukraine). Inst. Yadernykh Issledovanij); Zaritskij, N.S.; Mamchich, S.D. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 8.* [232p.] Order Number DE93630368. Source: OSTI; NTIS (US Sales Only); INIS.

Mechanical tensile test data of the ring-shaped specimens and results of the aluminium alloy SAW-1 structure investigation after reactor irradiation at the temperature of 40-60^{0}C and fast neutron fluence nearly $3.6x10^{26}m^{-2}$ ($E \geq 0.8$ MeV) are presented. The irradiated material ultimate elongation is 2.5% at the room test temperature. Mg_2Si-phase positive influence on the alloy irradiation resistance is showed. 9 refs.; 1 fig.; 2 tabs. (author).

26694 (INIS-mf–13547, pp. 118-124) **Structural damages of metal hafnium during reactor irradiation.** Risovanyj, V.D. (Nauchno-Issledovatel'skij Inst. Atomnykh Reaktorov, Dimitrovgrad (Russian Federation)); Klochkov, E.P.; Kosenkov, V.M.; Ostrovskij, Z.E. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 8.* [232p.] Order Number DE93630368. Source: OSTI; NTIS (US Sales Only); INIS.

Neutron-physical, mechanical and chemical properties of hafnium let it to be widely used as an absorbing and constructional material in nuclear reactor control system. Research reactor and post-reactor tests were held to substantiate performance of control system. Some results of hafnium structure investigation after reactor irradiation were presented. 6 figs. (author).

26695 (INIS-mf–13547, pp. 165-171) **Resistance to destruction of zirconium tubes in technological channels with account of radiation creeping and delayed hydrogen failure.** Kiselev, V.A. (Nauchno-Issledovatel'skij i Konstruktorskij Inst. Ehnergotekhniki, Moscow (Russian Federation)); Rivkin, E.Yu.; Rodchenkov, B.S. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 8.* [232p.] Order Number DE93630368. Source: OSTI; NTIS (US Sales Only); INIS.

Estimation of the strength and durability of technological channel tubes from zirconium alloys at high levels of stresses and temperatures with account of crack-type defects development kinetics. 2 figs.; 1 tab. (author).

26696 (INIS-mf–13547, pp. 172-176) **Investigation and prediction of cladding materials deformation behaviour under rapid heating.** Pirogov, E.N. (Moskovskij Inzhenerno-Fizicheskij Inst., Moscow (Russian Federation)); Ankudinov, A.V.; Komarov, O.V.; Artyukhina, L.L.; Egorov, V.I. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 8.* [232p.] Order Number DE93630368. Source: OSTI; NTIS (US Sales Only); INIS.

The investigation results connected with prediction of cladding materials deformation behaviour under accident situations conditions are presented. The necessity of preliminary studying of material structural evolution on different temperature levels is underlined. For 0Kh16N15M3BP steel the dependence of plastic deformation from stress, temperature and heating rate is given. For Zr-1%Nb alloy the polymorphic transformation temperature intervals is defined for heating rate to 500 K/s. 4 refs.; 5 figs. (author).

26697 (INIS-mf–13547, pp. 177-184) **Efficiency of collisional precipitate resolution.** Wollenberger, H. (Hahn-Meitner-Institut Berlin GmbH (Germany)). AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 8.* [232p.] Order Number DE93630368. Source: OSTI; NTIS (US Sales Only); INIS.

The morphology of a multi-phase structure under irradiation is determined by the counteraction of precipitate dissolution due to cascade mixing and re-precipitation due to freely migrating irradiation-induced point defects. A steady state boundary may occur when the precipitate volume change rates due to the two processes match each other. Such a boundary was observed for a Cu-Ni-Fe alloy. Consideration of the detection limit for precipitate dissolution focusses attention to the magnitude of the dissolution rate. A new method for determining dissolution rates by atom probe analysis is described. Measured data are compared with cascade mixing rates as determined in ion beam mixing experiments. 11 refs.; 3 figs. (author).

26698 (INIS-mf–13547, pp. 185-196) **Low activated chromium-base alloys.** Trefilov, V.I.; Zelenskij, V.F.; Neklyudov, A.N. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 8.* [232p.] Order Number DE93630368. Source: OSTI; NTIS (US Sales Only); INIS.

Results on the investigation of radiation resistance of three groups of chromium alloys after accelerator irradiation and under reactor condition are presented. These alloys are suggested as low activated materials for fusion (low alloying - with chromium content more than 95%wt., high-alloying - with Cr content more than 50% wt. and alloys with Cr content between 27 and 45% wt.). High resistivity of chromium alloys to void swelling, radiation creep and high temperature radiation embrittlement are shown. Degree of radiation embrittlement depends on content of alloying elements and gas impurities. 14 refs.; 11 figs. (author).

26699 (INIS-mf–13547, pp. 132-143) **Study of swelling and radiation creeping in construction materials of fuel assembly wrappers at BN-350 reactor on results of their form changes.** Karaulov, V.N. (Mangyshlakskij Ehnergokombinat, g.Shevchenko (Russian Federation)); Shkol'nik, T.G. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 8.* [232p.] Order Number DE93630368. Source: OSTI; NTIS (US Sales Only); INIS.

Vacancy swelling and radiation creeping (RC) of construction steels and alloys at BN-350 reactor according to data about the form change of fuel assembly wrappers which obtained high damaging doses was studied. For 12Kh18N10T MTO and O8Kh16N11M3 MTO steels a dependence of RC module on temperature was established. Swelling of these steels is described good by a power dependence on irradiation dose. 3 refs.; 9 figs.; 4 tabs. (author).

26700 (KAPL–4737) **The effect of processing on the microstructure and tensile properties of a γ-TiAl based alloy.** Fuchs, G.E. Knolls Atomic Power Lab., Schenectady, NY (United States). Feb 1993. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC12-76SN00052. (CONF-920604–4: 7. world conference and exhibition on titanium, San Diego, CA (United States), 28 Jun - 2 jul 1992). Order Number DE93013221. Source: OSTI; NTIS; INIS; GPO Dep.

Compositional and microstructural control, and alloying additions have been the primary methods used to increase the low temperature ductility of TiAl-based alloys. However, very little has been done to characterize the effect of processing on ductile γ-TiAl alloys. This study examines effect of processing on microstructure and properties of cast, wrought and powder metallurgy TiAl-based alloys with a similar nominal composition. The alloy was Ti-48Al-2Nb-2Cr (at. %). After processing, all of the samples were heat treated in the $\alpha + \gamma$ phase field. Microstructures were characterized by optical, scanning electron and transmission electron microscopy. Tensile properties were evaluated in the temperature range 25–1000C in air. The powder processed alloys exhibited the highest strength and ductility at test temperatures up to 850C. All of the alloys exhibited similar tensile properties at 1000C. Examination of fracture surfaces indicated that tensile failure occurred by predominantly transgranular cleavage at temperatures below 700C. However, above 850C, significant plastic deformation was observed, particularly in the powder metallurgy samples. The interrelationships of processing-microstructure-mechanical properties of Ti-48Al-2Nb-2Cr (at. %) will be discussed.

26701 (LA-UR–93-669) **Metastable phases in mechanically alloyed aluminum germanium powders.** Yvon, P.J.; Schwarz, R.B. Los Alamos National Lab., NM (United States). [1993]. 21p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9309104–1: 2. structural applications of mechanical alloying conference, Vancouver (Canada), 20-22 Sep 1993). Order Number DE93008727. Source: OSTI; NTIS; GPO Dep.

Aluminum and germanium form a simple eutectic system with no stable intermetallic phase, and limited mutual solubility. We report the formation of a metastable rhombohedral,γ_1 phase by mechanically alloying aluminum and germanium powders. This phase, which appears for compositions between 20 and 50 at. % germanium, has also been observed in rapidly quenched alloys, but there is disagreement as to its composition. By measuring the heat of crystallization as a function of composition, we determined the composition of the γ_1 phase to be $Al_{70}Ge_{30}$. We also produced $Al_{70}Ge_{30}$ by arc melting the pure elements, followed by splat-quenching at a cooling rate in the range of 10^8 K s^{-1}. This method produced two metastable phases, one of which was found to be the γ_1 phase obtained by mechanical alloying. The other was a monoclinic phase reported earlier in the literature as γ_2.

26702 (LA-UR–93-712) **The effect of oxygen, grain size, and strain rate on the mechanical behavior of forged P/M tantalum.** Michaluk, C.A. (Cabot Corp., Boston, MA (United States)); Gray, G.T. III; Chatterjee, T. Lawrence Livermore National Lab., CA (United States). [1993]. 10p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9302111–1: Powder metallurgy in aerospace, defense, and demanding applications, San Diego, CA (United States), 8-11 Feb 1993). Order Number DE93011251. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The effect of oxygen, grain size, and strain rate on the quasistatic and dynamic mechanical properties of extruded, forged, and annealed P/M tantalum containing two different levels of oxygen is addressed. The high oxygen (250–400 ppM) P/M materials were characterized as having higher flow stress and greater work hardening than wrought high purity tantalum. Work hardening and relative strain rate sensitivity exponents of the P/M materials were found to be relatively independent of oxygen level and grain size and slightly dependent on strain rate. This behavior may be due to the existence of fine dispersion of tantalum oxide particles. The state of oxygen in the P/M forgings was investigated by TEM analysis.

26703 (LA-UR–93-1142) **Excimer laser surface processing of titanium.** Jervis, T.R.; Hubbard, K.M.; Zocco, T.G.; Foster, L.; Nastasi, M.; Tesmer, J.R. Los Alamos National Lab., NM (United States). [1993]. 26p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9302103–2: Annual meeting of the Minerals, Metals and Materials Society (TMS), Denver, CO (United States), 22 Feb 1993). Order Number DE93012633. Source: OSTI; NTIS; GPO Dep.

We have examined the effect of laser surface processing of Ti alloys using pulsed excimer laser light at 248 nm. Thermal transformations of the surface are accomplished by heating the surface and rapid cooling. Alloying and formation of compounds can be obtained by melting and mixing surface layers into the material and by gas alloying. Multiple melting-resolidification cycles result in the inter-diffusion of surface layers in the liquid state and the diffusion of gas species into the material. The effect of alloying from both solid and gas sources and the effects of thermal transformations on the microstructure and surface hardness properties of these alloys will be examined.

26704 (LA-UR–93-1150) **Ploughing on gold using a Scanning Tunneling Microscope.** Day, R.D. (Los Alamos National Lab., NM (United States)); Russell, P.E. Los Alamos National Lab., NM (United States). [1993]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9304138–1: Principles of cutting mechanics, Tucson, AZ (United States), 13-15 Apr 1993). Order Number DE93012632. Source: OSTI; NTIS; GPO Dep.

Purpose of the our experiments is to measure the nominal force on the sample induced by the tip as a function of voltage and tunneling current and use the imaging capabilities of the STM to determine if the sample materials surface can be deformed plastically in a controlled manner by the tip in our investigations we use the tip as a ploughing tool which can be moved in a line to create a furrow, or can be scanned in a plane to displace a pocket of material. This abstract describes how we measure the tunneling force, presents some of the data acquired to date, and shows evidence of plastic deformation caused by the tip.

26705 (LA-UR–93-1201) **Mechanical properties of excimer laser modified titanium surfaces.** Jervis, T.R.; Zocco, T.G.; Hubbard, K.M.; Nastasi, M. Los Alamos National Lab., NM (United States). [1993]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9304136–1: MRS symposium on thin films, stresses and mechanical properties, Pittsburgh, PA (United States), 12-16 Apr 1993). Order Number DE93012663. Source: OSTI; NTIS; GPO Dep.

Excimer laser processing enables both thermally-driven transformations and the incorporation of solutes into the surface of materials through melting and diffusional mixing. We have examined the effect of excimer laser processing on the microstructure and surface mechanical properties of titanium alloys. Changes in the surface hardness due to laser processing were studied using a Nanoindenter ™. Alloying experiments using both mixing of evaporated surface layers of boron and laser gas alloying in air and in nitrogen all result in changes in the surface hardness of the material. Alloying with boron results in an amorphous surface which is somewhat harder than the as polished surface. Laser processing in air and pure nitrogen results in incorporation of oxygen and nitrogen and the development of fine ($\sim$ 50 nm) precipitates of TiO and TiN respectively. Substantial increases in surface hardness result due to solution and precipitation mechanisms. The effects of alloying on the surface hardness of the materials will be discussed in terms of the concentration of the solute and microstructures observed.

26706 (LA-UR–93-1395) **Ternary alloying effects in polycrystalline β-NiAl.** Cotton, J.D. (Los Alamos National Lab., NM (United States)); Noebe, R.D.; Kaufman, M.J. Los Alamos National

Lab., NM (United States). [1993]. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930997–1: International symposium on structural intermetallics, Champion, PA (United States), 26-30 Sep 1993). Order Number DE93012675. Source: OSTI; NTIS; GPO Dep.

Purpose of this paper is to summarize alloying research to date in polycrystalline NiAl and its impact on microstructure and ambient temperature properties. It is divided into the following sections: phase equilibria, solid solution effects and precipitation effects. Alloys that contain a high volume fraction of second phase (e.g. pseudobinary eutectic compositions) are not considered. Rather, the effects of dilute to moderate ternary alloying additions on the structure and properties of β-NiAl are reviewed. It is already well established that stoichiometry is paramount in controlling mechanical properties of the binary compound. Since the addition of a third element is equally important, ternary phase equilibria are reviewed first. Solid solution strengthening is probably the least well understood particularly with respect to the nature of point defects and their contribution to strength. Characterization of these defects and their role in mechanical properties may well hold the key to future development of NiAl-based materials. With regard to second phases, there is limited evidence that the classical precipitation hardening mechanisms for metals are also applicable to NiAl.

26707 (LA-UR–93-1785) **Shock compression and quasielastic release in tantalum.** Johnson, J.N.; Hixson, R.S.; Tonks, D.L.; Gray, G.T. III. Los Alamos National Lab., NM (United States). [1993]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9306167–3: 14. international conference on high pressure science and technology and 1993 technical meeting of the topical group on shock compression of condensed matter, Colorado Springs, CO (United States), 28 Jun - 3 jul 1993). Order Number DE93014566. Source: OSTI; NTIS; GPO Dep.

Previous studies of quasielastic release in shock-loaded FCC metals have shown a strong influence of the defect state on the leading edge, or first observable arrival, of release wave, due to large density of pinned dislocation segments behind the shock front, their relatively large pinning separation, and a very short response time as determined by drag coefficient in shock-compressed state. This effect is entirely equivalent to problems associated with elastic moduli determination using ultrasonic methods. This is particularly true for FCC metals, which have an especially low Peierls stress, or inherent lattice resistance, that has little influence in pinning dislocation segments and inhibiting anelastic deformation. BCC metals, on the other hand, have a large Peierls stress that essentially holds dislocation segments in place at low net applied shear stresses and thus allows fully elastic deformation to occur in the complete absence of anelastic behavior. Shock-compression and release experiments have been performed on tantalum (BCC), with the observation that the leading release disturbance is indeed elastic. This conclusion is established by examination of experimental VISAR records taken at the tantalum/sapphire (window) interface in a symmetric-impact experiment which subjects the sample to a peak longitudinal stress of approximately 7.3 GPa, in comparison with characteristic code calculations.

26708 (LA-UR–93-2323) **Differential Sensitivity Theory applied to the MESA code for high pressure interactions.** Maudlin, P.J.; Henninger, R.J.; Harstad, E.N. Los Alamos National Lab., NM (United States). [1993]. 13p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9306167–5: 14. international conference on high pressure science and technology and 1993 technical meeting of the topical group on shock compression of condensed matter, Colorado Springs, CO (United States), 28 Jun - 3 jul 1993). Order Number DE93016460. Source: OSTI; NTIS; GPO Dep.

A technique called Differential Sensitivity Theory (DST) is applied to the system of equations solved by the MESA hydrocode. DST uses adjoint techniques to determine exact sensitivity derivatives, i.e., if R is a calculational result of interest (response R) and α_i is a calculational input (parameter α_i), then $\partial R/\partial\alpha_i$ is defined as the sensitivity. The advantage of using DST is that for an n-parameter problem all n sensitivities can be obtained by integrating the solutions from only two calculations, a MESA calculation and its corresponding adjoint calculation using an Adjoint Continuum Mechanics code (ACM). This work describes the derivation and solution of the appropriate set of adjoint and sensitivity equations for the purpose of computing sensitivities for high-rate two-dimensional, multi-component, high deformation problems. As an example, results are presented for a flyer plate problem.

26709 (LBL–33948) **Theory of the negative magnetoresistance in magnetic metallic multilayers.** Hood, R.Q. (California Univ., Berkeley, CA (United States). Dept. of Physics); Falicov, L.M. Lawrence Berkeley Lab., CA (United States). Apr 1993. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-930405–10: Spring meeting of the Materials Research Society, San Francisco, CA (United States), 12-16 Apr 1993). Order Number DE93013912. Source: OSTI; NTIS; GPO Dep.

The Boltzman equation is solved for a system consisting of alternating ferromagnetic normal metallic layers. The in-plane conductance of the film is calculated for two configurations: successive ferromagnetic layers aligned parallel and antiparallel to each other. Results explain the giant negative magnetoresistance encountered in these systems when an initial antiparallel arrangement is changed into a parallel configuration by application of an extemal magnetic field. The calculation depends on geometric parameters (the thicknesses of the layers); intrinsic metal parameters (number of conduction electrons, magnetization and effective masses in the layers); bulk sample properties (conductivity relaxation times); and interface scattering properties (diffuse scattering versus potential scattering at the interfaces). It is found that a large negative magnetoresistance requires, in general, considerable asymmetry in the interface scattering for the two spin orienmtions. All qualitative features of the experiments are reproduced. Quantitative agreement can be achieved with sensible values of the parameters. The effect can be conceptually explained based on considerations of phase-space availability for an electron of a given spin orientation as it travels through the multilayer sample in the various configurations and traverses the interfaces.

26710 (LBL–34012) **Microstructural influences on the mechanical properties of solder.** Morris, J.W. Jr.; Goldstein, J.L.F.; Mei, Z. Lawrence Berkeley Lab., CA (United States). Apr 1993. 48p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-9209360–1: 3. international workshop on materials and mechanics issues of solder alloy applications, Santa Fe, NM (United States), 9-11 Sep 1992). Order Number DE93015044. Source: OSTI; NTIS; GPO Dep.

Intent of this book is to review analytic methods for predicting behavior of solder joints, based on continuum mechanics. The solder is treated as a continuous, homogeneous body, or composite of such bodies, whose mechanical behavior is uniform and governed by simple constitutive equations. The microstructure of a solder joint influences its mechanical properties in 3 ways: it governs deformation and failure; common solders deform inhomogeneously; and common solders are microstructurally unstable. The variety of microstructures often found in solder joints are briefly reviewed, and some of the ways are discussed in which the microstructure influences the common types of high-temperature mechanical behavior. 25 figs, 40 refs.

26711 (LBL–34028) **The low-temperature specific heat of $CeCu_2Ge_2$ at 0 and 9.5 kbar.** Fisher, R.A. (Lawrence Berkeley Lab., CA (United States)); Emerson, J.P.; Phillips, N.E.; Caspary, R.; Steglich, F. Lawrence Berkeley Lab., CA (United States). Apr 1993. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-930801–4: Conference of the International Union of Pure and Applied Physics on low temperature physics (LT 20), Eugene, OR (United States), 1-11 Aug 1993). Order Number DE93014914. Source: OSTI; NTIS; GPO Dep.

$CeCu_2Ge_2$ orders antiferromagnetically, $T_N \sim 4K$, and $\gamma(T) \sim 200\ mJ/K^2 \cdot mole$ near 0.5K and P = 0. A pressure of 9.5 kbar has no measurable effect on T_N; reduces slightly the specific-heat anomaly at T_N; and reduces slightly $\gamma(T)$ below 0.7K. These effects of pressure are in striking contrast to the much stronger effects on other heavy-fermion compounds, e.g., $CeAl_3$, URu_2Si_2 and $CeCu_2Si_2$.

26712 (NEI-SE–120) **Corrosion of underground water pipes due to acidification of soil and groundwater.** Levlin, E. Royal Inst. of Tech., Stockholm (Sweden). Dept. of Water Resources Engineering. Mar 1992. 28p. Order Number DE93500845. Source: OSTI; NTIS.

Paper no 2 to TRITA-TEK–92-01.

The anthropogenic acidification creates changes of soil and groundwater that may contribute to increased corrosion of water pipe systems, buried in the ground. Investigations on the influence of acidification on corrosion of underground water pipes are being performed, which include studies of damage frequency statistics and laboratory experiments. The purpose of this literature survey is to establish the state-of-the-art as background for these investigations. The soil chemistry and the changes caused by acidification, as well as the connection between soil properties and corrosion, are two topics which are essential for the understanding of the influence of acidification on the corrosion of metallic structures in the ground. As cast-iron is the material most used for underground water pipes, the corrosion mechanisms of cast-iron are important. Of interest are also reports on corrosion damages to water pipes in soil and on laboratory investigations on soil corrosion. Laboratory investigations make possible the separation of the factors contributing to corrosion and allow the magnitude of the acidification factor to be determined. (51 refs., 11 figs., 11 tabs.).

26713 (NUREG/CR–4744-Vol.7-No.1) **Long-term embrittlement of cast duplex stainless steels in LWR systems: Semiannual report, October 1991–March 1992: Volume 7, No.1.** Chopra, O.K. (Argonne National Lab., IL (United States)). Nuclear Regulatory Commission, Washington, DC (United States). Div. of Engineering; Argonne National Lab., IL (United States). May 1993. 165p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract W-31109-ENG-38. (ANL–92/42-Vol.7-No.1). Source: OSTI; NTIS; INIS; GPO.

This progress report summarizes work performed by Argonne National Laboratory on long-term thermal embrittlement of cast duplex stainless steels in LWR systems during the six months from October 1991 to March 1992. Charpy-impact, tensile, and fracture toughness J-R curve data are presented for several heats of cast stainless steel that were aged 10,000-58,000 h at 290, 320, and 350°C. The results indicate that thermal aging decreases the fracture toughness of cast stainless steels. In general, CF-3 steels are the least sensitive to thermal aging and CF-8M steels are the most sensitive. The values of fracture toughness J_{IC} and tearing modulus for CF-8M steels can be as low as $\approx$90 kJ/m^2 and $\approx$60, respectively. The fracture toughness data are consistent with the Charpy-impact results, i.e. unaged and aged steels that show low impact energy also exhibit lower fracture toughness. All steels reach a minimum saturation fracture toughness after thermal aging; the time to reach saturation depends on the aging temperature. The results also indicate that low-strength cast stainless steels are generally insensitive to thermal aging.

26714 (ORNL/NPR–92/65) **The corrosion behavior of 8001 Al under heat-transfer conditions in an aqueous loop system.** Pawel, R.E.; Felde, D.K.; McFee, M.T.; Clinard, J.A. Oak Ridge National Lab., TN (United States). Apr 1993. 135p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93013450. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Specimens of 8001 aluminum were exposed to flowing water under heat-transfer conditions relevant to the proposed New Production Reactor-heavy-water reactor (NPR-HWR) in a Corrosion Test Loop System. The growth of oxide films on the reacting surfaces was characterized by temperature measurements on the specimen during the course of the experiments and by post-test examinations and analyses of the specimens. For all tests, the major reaction product was boehmite ($Al_2O_3 \cdot H_2O$) with, in many instances, a thin, iron-rich outer layer that formed as a consequence of aqueous mass transport from the cooler stainless steel sections of the loop. In a series of five tests, each up to eight weeks in duration, the measured film growth rates were shown to be sensitive to both thermal-hydraulic and chemical variables and were compared to the predictions of existing data correlations.

26715 (PNL-SA–22257) **Interfacial precipitation, segregation and deformation in alloy 600: Implications on primary-side IGSCC.** Bruemmer, S.M. Pacific Northwest Lab., Richland, WA (United States). Apr 1993. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-9304146–1: Alloy 600 experts meeting, Warrenton, VA (United States), 5-9 Apr 1993). Order Number DE93013161. Source: OSTI; NTIS; GPO Dep.

A great many unknowns still exist concerning the mechanisms controlling intergranular stress corrosion cracking (IGSCC) of alloy 600 in high-temperature, deaerated water environments. Any proposed mechanism must involve the microstructure, microchemistry and mechanical properties of grain boundary regions. To facilitate basic understanding, specific aspects of alloy 600 metallurgy are reviewed and discussed. Interfacial carbide precipitation, chromium depletion, impurity segregation and local deformation characteristics are examined and related to IGSCC behavior. Purpose of this paper is to provide information, and prompt discussion, on these various issues for the EPRI Alloy 600 Experts Meeting.

26716 (SAND–92-2508C) **Effects of growth conditions and substrate orientation on the properties of InSb.** Biefeld, R.M.; Baucom, K.C. Sandia National Labs., Albuquerque, NM (United States). [1992]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-930405–7: Spring meeting of the Materials Research Society, San Francisco, CA (United States), 12-16 Apr 1993). Order Number DE93013766. Source: OSTI; NTIS; GPO Dep.

Two new organometallic Sb sources, tris(dimethylamino)antimony (TDMASb), and tertiarybutyldimethylantimony (TBDMSb) are being investigated. Growth of InSb using TDMASb, or TBDMSb and TMIn was investigated at 350 to 475C using a range of V/III ratios, growth rates and pressures. Misoriented InSb substrates were also used for selected growth conditions. The growth rates of InSb using TMIn and either TDMASb or TBDMSb at temperatures $\leq$ 425C were proportional to both the TMIn flow rate and the temperature. The surface morphology of InSb grown using either TDMASb or TBDMSb was very rough for growth temperatures $\leq$ 425C. This may be due to the complex decomposition mechanisms involved and the presence of methyl groups on the surface. Smoother backgrounds were generally found when using off axis substrates. The details of the defects observed on the surfaces were dependent on the type of misorientation and can be related to the atomic structure of the surface steps. Both n- and p-type InSb were grown using TBDMSb or TDMASb and TMIn with mobilities up to 68,990 and 7773 cm^2/Vs, respectively, at 77 K. The mobility for InSb using either TDMASb or TBDMSb was optimized by going to lower temperatures, pressures and V/III ratios. The opposite was true for surface morphology which improved with higher temperature, pressure, and V/III ratio. The growth of high mobility InSb with smooth surfaces at T $\leq$ 425C was not achieved with TDMASb or TBDMSb and TMIn under the conditions investigated in this work.

26717 (SAND–93-0027) **Multiphase equation of state for iron.** Kerley, G.I. Sandia National Labs., Albuquerque, NM (United States). Feb 1993. 64p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93013956. Source: OSTI; NTIS; GPO Dep.

The PANDA code is used to build a multiphase equation of state (EOS) table for iron. Separate EOS tables were first constructed for each of the individual phases. The phase diagram and multiphase EOS were then determined from the Helmholtz free energies. The model includes four solid phases (α,γ, δ, and ϵ) and a fluid phase (including the liquid, vapor, and supercritical regions). The model gives good agreement with experimental thermophysical data, static compression data, phase boundaries, and shock-wave measurements. Contributions from thermal electronic excitation, computed from a quantum-statistical-mechanical model, were found to be very important. This EOS covers a wide range of densities (0–1000 g/cm^3) and temperatures (0–1.2$\times$10^7 K). It is also applicable to RHA steel. The new EOS is used in hydrocode simulations of plate impact experiments, a nylon ball impact on steel, and the shaped charge perforation of an RHA plate. The new EOS table can be accessed through the SNL-SESAME library as material number 2150.

26718 (SAND–93-1013C) **Microstructural mechanisms that enhance electromigration resistance in Al–Cu thin films.** Frear, D.R.; Michael, J.R. Sandia National Labs., Albuquerque, NM (United States). [1993]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-930405–8: Spring meeting of the Materials Research Society, San Francisco, CA (United States), 12-16 Apr 1993). Order Number DE93013770. Source: OSTI; NTIS; GPO Dep.

Evolution of the microstructure of Al-2wt.%Cu thin films is examined with respect to how the presence of copper can influence electromigration behavior. After an anneal that simulates a thin film sintering step, the microstructure of the Al-Cu films consisted of 1 μm aluminum grains with θ-phase Al_2Cu precipitates at grain boundaries and triple points. The grain size and precipitation distribution did not change with subsequent heat treatments. Upon cooling to room temperature the heat treatment of the films near the Al/Al+θ solvus temperature results in depletion of copper at the aluminum grain boundaries. Heat treatments lower in the two phase region (200 to 300C) result in enrichment of copper at the aluminum grain boundaries. Here, it is proposed that electromigration behavior of aluminum is improved by adding copper because the copper enrichment in the form of Al_2Cu phase may hinder aluminum diffusion along the grain boundaries.

26719 (SVF–462) **The effect of chlorine on CFB furnace wall tubes.** Haeggblom, E. (Studsvik Material AB, Nykoeping (Sweden)). Stiftelsen foer Vaermeteknisk Forskning, Stockholm (Sweden); Studsvik Material AB, Nykoeping (Sweden). 1992. 31p. (In Swedish). (STUDSVIK-M–92-93). Order Number DE93500702. Source: OSTI; NTIS.

The aim of this work was to assess if chlorine in the combustion gas in a circulating fluidised bed (CFB) influences the erosion-corrosion properties of the furnace wall tubes. Specimens of carbon steel, stainless steel and a nickel base alloy have been subject to simultaneous erosion and corrosion at high temperature in the laboratory. Hydrogen chloride was injected into the gas atmosphere. Hydrogen chloride, in concentrations corresponding to those in waste incinerator untreated flue gas, affects the corrosion rates of carbon steel considerably. If the metal temperature is high enough, the metal wastage may reach unacceptable levels. Oxide scales formed are porous and contain high amounts of iron chloride. The scales have low resistance to particle erosion. The high alloyed materials were only slightly attacked in this experiment. (15 figs., 3 tabs.).

26720 (TRITA-TEK–92-01) **Corrosion of water pipe systems due to acidification of soil and groundwater.** Levlin, E. Royal Inst. of Tech., Stockholm (Sweden). Dept. of Applied Electrochemistry and Corrosion Science. 1992. 30p. Order Number DE93500842. Source: OSTI; NTIS.

The influence of acidification on the external corrosion of pipes buried in the soil, was studied in a damage frequency analysis, but no connection was found. The corrosion in soil appears to be mainly dependent on other factors than acidification, such as the type of soil. With respect to the position of the pipe in the soil three cases can be distinguished: (i) Pipes in aerobic soil high above the groundwater level suffer from corrosion due to rich oxygen supply. The corrosion is, however, gradually stifled by precipitation of iron oxides. (ii) Pipes in anaerobic soil below the groundwater level may corrode due to the absence of protective corrosion products. However, depending on the H_2S/Fe^{2+}-ratio a protective layer of FeS may precipitate. (iii) On pipes just above the groundwater level corrosion by the action of aeration cells may occur due to good oxygen supply combined with a fairly low resistivity. Laboratory experiments simulating aeration cell corrosion were carried out with two parallel cells, of which one was sprayed with acidified and the other with non-acidified water. In another investigation the geographical distribution of corrosion induced water damages was compared with the distribution of acidification effects, and a significant correlation was observed. Due to changes in the supply water quality, primarily the pH value, the alkalinity and the sulphate content, the acidification of the groundwater may lead to increased internal corrosion of water pipe installations in buildings. (30 refs., 8 figs.).

26721 (TRITA-VAT–3884) **Corrosion of underground water pipes due to acidification by air pollution - Damage frequency analysis.** Levlin, E. Royal Inst. of Tech., Stockholm (Sweden). Dept. of Water Resources Engineering. Dec 1991. 16 p.p. Order Number DE93500848. Source: OSTI; NTIS.

Paper no 3 to TRITA-TEK–92-01.

The purpose of this investigation is to study how the corrosion of underground water pipes is influenced by acidification generated due to anthropogenic air pollution and the subsequent precipitation which affects the chemical properties of soil and the ground water. This investigation is based on 39 reported corrosion damages to municipal water conduits from eight municipalities in different parts of Sweden. The chosen municipalities are: Ale, Gothenburg, Helsingborg, Ljungby, Piteaa, Timraa, Stockholm and Vaexjoe. In order to assess the natural corrosivity of the soil and the influence of acidification on it, soil samples were collected from the respective damage sites and analysed. No direct relation between the pH-level and the corrosion damage frequency could be established. The reason may be that the corrosion damages on water pipes, especially corrosion caused by differential aeration, are more frequent in clay than in silt soil. Since clay has the property to weather more easily, it is more resistant to acidification, and has a lower resisitivity, larger ionic strength and higher pH-value. Some relations between sulphate content, total sulphur concentration and life span, however, have been noticed indicating that the corrosion increases with accelerating acidity. In order to reach a definite and more precise conclusion, a larger study involving a large number of corrosion damages would have been required. (8 refs., 8 figs., 2 tabs.).

26722 (TRITA-VAT–4912) **Corrosion of cast-iron in soil.** Levlin, E. Royal Inst. of Tech., Stockholm (Sweden). Dept. of Water Resources Engineering. Dec 1991. 11 p.p. Order Number DE93500851. Source: OSTI; NTIS.

Paper no 6 to TRITA-TEK–92-01.

According to one theory corrosion of cast iron in anaerobic soil is caused by differential aeration cells and according to another theory, corrosion is caused by sulphate reducing bacteria. The ratio between H_2S and Fe^{2+}-ratio, is playing an important role in determining whether there will be corrosion on cast-iron in anaerobic soil. In anaerobic soil the stability of FeS is much higher than the stability of oxidic corrosion products. At high H_2S concentrations in the soil, precipitation of a protective film of FeS can occur on the iron surface. However, a high Fe^{2+} concentration in the soil will create a low H_2S concentration due to precipitation of FeS in the bulk of the soil and no FeS will be deposited on the iron surface. A differential aeration cell is created when one part of a construction is exposed to soil with a high content of oxygen, while another part is exposed to soil with a low oxygen content and as a consequence becoming anode and corroding. The dissolution of Fe^{2+} at the anode surfaces increases and the H_2S/Fe^{2+}-ratio becomes small and as a consequence uniform corrosion will occur. Sulphate reducing bacteria increase the H_2S/Fe^{2+}-ratio by producing H_2S through simultaneous oxidation of organic matter in the soil, and thereby promote passivation of the iron surface by the formation of a FeS coating. Local variations in the H_2S/Fe^{2+}- ratio may create a porous film, resulting in pitting corrosion. (13 refs., 6 figs.).

26723 (UCRL-JC–107859) **Large spatial, temporal, and algorithmic adaptivity for implicit nonlinear finite element analysis.** Engelmann, B.E.; Whirley, R.G. Lawrence Livermore National Lab., CA (United States). 30 Jul 1992. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-921110–51: Winter annual meeting of the American Society of Mechanical Engineers (ASME), Anaheim, CA (United States), 8-13 Nov 1992). Order Number DE93016438. Source: OSTI; NTIS; GPO Dep.

The development of effective solution strategies to solve the global nonlinear equations which arise in implicit finite element analysis has been the subject of much research in recent years. Robust algorithms are needed to handle the complex nonlinearities that arise in many implicit finite element applications such as metalforming process simulation. The authors experience indicates that robustness can best be achieved through adaptive solution strategies. In the course of their research, this adaptivity and flexibility

has been refined into a production tool through the development of a solution control language called ISLAND. This paper discusses aspects of adaptive solution strategies including iterative procedures to solve the global equations and remeshing techniques to extend the domain of Lagrangian methods. Examples using the newly developed ISLAND language are presented to illustrate the advantages of embedding temporal, algorithmic, and spatial adaptivity in a modern implicit nonlinear finite element analysis code.

26724 (UCRL-JC–109359-Rev.1) **Ion assisted sputter deposition of Mo-Si multilayers: Revision 1.** Vernon, S.P. (Vernon Applied Physics, Torrance, CA (United States)); Stearns, D.G.; Rosen, R.S. Lawrence Livermore National Lab., CA (United States). Nov 1992. 20p. Sponsored by USDOE, Washington, DC (United States); Department of Defense, Washington, DC (United States). DOE Contract W-7405-ENG-48. Contract L1228. (CONF-9204120–9-Rev.1: Soft-x-ray projection lithography topical meeting, Monterey, CA (United States), 6-8 Apr 1992). Order Number DE93013830. Source: OSTI; NTIS; GPO Dep.

X-ray multilayer (ML) structures fabricated utilizing magnetron sputter deposition exhibit a degradation instructural quality with increased deposition pressure. The observed change in morphology is attributed to a reduced mobility of surface adatoms which inhibits the formation of smooth, continuous layers. The application of a negative substrate bias produces ion bombardment of the growing film surface by sputtering gas ions extracted from the plasma and allows direct control of the energy density supplied to the film surface during thin film growth. The technique supplements the energy lost to thermalization in high pressure deposition and permits the fabrication of high quality ML structures at elevated processing pressures. A three fold improvement in the soft x-ray normal incidence reflectance (NIR) at 130 Å results for substrate bias voltages of order ~ -150V for Mo-Si MLs deposited at 10 mTorr Ar.

26725 (UCRL-JC–109651) **Grain-boundary electronic states by multiple-scattering theory.** Sowa, E.C.; Gonis, A. Lawrence Livermore National Lab., CA (United States). Aug 1992. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-920927–4: 2. international conference and exhibition on computer applications to materials and molecular science and engineering, Yokohama (Japan), 22-25 Sep 1992). Order Number DE93013198. Source: OSTI; NTIS; GPO Dep.

In order to calculate the electronic structure of grain boundaries, it is necessary to treat properly the lack of translational symmetry in directions perpendicular to the interface between two half solids. This treatment can be provided on the basis of multiple-scattering theory. We have developed a formalism which allows the exact treatment of the Schroedinger equation for systems with reduced translational symmetry, yielding solutions which in the converged limit satisfy the proper boundary conditions imposed by the geometry of the system. We report the first application of this real-space multiple-scattering theory to the calculation of the local density of states (DOS) at metallic grain boundaries. We exhibit and compare local DOS's at selected sites for both unrelaxed and relaxed Σ5 (100) 36° twist and Σ5 (310) tilt grain boundaries in Cu, where the atomic coordinates of the relaxed configurations were obtained with the Embedded Atom Method. We discuss briefly the main features of our method, and give our plans for future work.

26726 (UCRL-JC–109917) **Interstitial embrittlement in vanadium laser welds.** Strum, M.J.; Wagner, L.M. Lawrence Livermore National Lab., CA (United States). 24 Feb 1992. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-911296–10: 14. international conference on laser and applications, San Diego, CA (United States), 8-13 Dec 1991). Order Number DE93012588. Source: OSTI; NTIS; GPO Dep.

Efficiencies of interstitial absorption during pulsed ND:YAG laser welding of vanadium were compared for nitrogen, oxygen, hydrogen, and water vapor. Influence of interstitial levels on the embrittlement of vanadium laser welds was also measured. For 1000 ppM contaminant levels in the weld atmosphere, weld hydrogen content increased 9 ppM, nitrogen content increased 190 ppM, and oxygen content increased from 500 ppM relative to baseplate levels. Welds in ultrahigh-purity argon atmospheres contained 3 ppM hydrogen, 40 ppM nitrogen, and 250 ppM oxygen. Longitudinal all-weld tensile specimens and notched-plate specimens were used to measure weld metal tensile properties at −55C. All of the laser weld notch-strength ratios exceeded unity and weld metal tensile strengths all exceeded the baseplate values. For 1000 ppM atmosphere contaminant levels, the only significant decrease in ductility, as measured by reduction-in-area at fracture was for the weld atmosphere containing oxygen. Weld atmospheres containing 1% nitrogen also reduced the weld ductility, and resulted in the onset of cleavage fracture.

26727 (UCRL-JC–110128) **Modeling microstructural evolution and the mechanical response of superplastic materials.** Lesuer, D.R.; Syn, C.K.; Cadwell, K.L.; Preuss, C.S. Lawrence Livermore National Lab., CA (United States). 11 Jan 1993. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-921109–5: Fall meeting of the Metallurgical Society and American Institute of Metallurgical and Petroleum Engineers, Chicago, IL (United States), 1-5 Nov 1992). Order Number DE93014417. Source: OSTI; NTIS; GPO Dep.

A model has been developed that accounts for grain growth during, superplastic flow and its subsequent influence on stress-strain-strain rate behavior. These studies are experimentally based and have involved two different types of superplastic materials – a quasi-single phase metal (Coronze 638) and a microduplex metal (ultrahigh-carbon steel - UHCS). In both materials the kinetics of strain-enhanced grain growth have been studied as a function of strain, strain rate and temperature. An equation for the rate of grain growth has been developed that incorporates the influence of temperature. The evolution of the grain size distribution during superplastic deformation has also been investigated. Our model integrates grain growth laws derived from these studies with two mechanism based, rate dependent constitutive laws to predict the stress-strainstrain rate behavior of materials during superplastic deformation. The influence of crain size distribution and its evolution with strain and strain rate on the stress-strain-strain rate behavior has been represented through the use of distributed parameters. The model can capture the stress-strain-strain rate behavior over a wide range of strains and strain rates with a single set of parameters. Many subtle features of the mechanical response of these materials can be adequately predicted.

26728 (UCRL-JC–110669) **Laser weld repair of tantalum sheet.** Oldani, J.J.; Westrich, C.N. Lawrence Livermore National Lab., CA (United States). Dec 1992. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-921256–4: 1992 international conference on lasers, Houston, TX (United States), 7-11 Dec 1992). Order Number DE93016417. Source: OSTI; NTIS; GPO Dep.

Tantalum sheets which are used in radiographic film cassettes for high explosives studies were repaired using Nd:YAG laser welding. The tantalum sheets can receive various levels of indentations and/or scratches which can leave radiographic indications during use in subsequent studies. Laser welding using a Raytheon 400 watt Nd:YAG laser and a 0.010 inch diameter tantalum filler wire with argon cover gas was used to fill in these false indications. A successful weld repair is required to give no radiographic indications, neither high nor low density readings.

26729 (UCRL-JC–110687) **Effect of pressure on order and stability in alloys: The case of Al-Ge.** Turchi, P.E.A. (Lawrence Livermore National Lab., CA (United States)); Sluiter, M.; Stocks, G.M. Lawrence Livermore National Lab., CA (United States). 1 Dec 1992. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48 ;AC05-84OR21400. (CONF-921101–115: 16. Material Research Society international symposium on the scientific basis for nuclear waste management fall meeting, Boston, MA (United States), 30 Nov - 5 dec 1992). Order Number DE93013842. Source: OSTI; NTIS; GPO Dep.

A parameter-free approach to phase stability in substitutional alloys is applied to the influence of pressure on order-disorder phenomena in Al-Ge. The methodology is based upon an application of the Generalized Perturbation Method to the Korringa-Kohn-Rostoker scattering formulation of the Coherent Potential Approximation. For fcc-based Al-Ge alloys, it is shown that the tendency towards phase separation at normal pressure originates from a structural difference between the pure species. By applying

pressure, the structural energy difference is reduced, and a significant increase in the tendency towards order, especially for Al-rich alloys, is theoretically observed, leading, as an example, to the possible observation of a DO_{22} ordered state around 25 at. %. The electronic origin of the ordering tendencies induced by pressure is discussed and the theoretical predictions are related to experimental facts.

26730 (UCRL-JC–111000) **Electronic structure and phase stability properties in ternary substitutional alloys.** Traiber, A.J.S. (Lawrence Livermore National Lab., CA (United States)); Sluiter, M.; Turchi, P.E.A.; Allen, S.M. Lawrence Livermore National Lab., CA (United States). 1 Dec 1992. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-921101–122: 16. Material Research Society international symposium on the scientific basis for nuclear waste management fall meeting, Boston, MA (United States), 30 Nov - 5 dec 1992). Order Number DE93013848. Source: OSTI; NTIS; GPO Dep.

Electronic structure and stability properties of ternary-metal alloys are examined using an extension of the Coherent Potential Approximation -Generalized Perturbation Method approach within the Tight-Binding description of the chemically random alloy. In particular, we report on calculations of density of states, mixing energies and effective cluster interactions which build up the ordering energy. The study focuses on the Ti-V-Fe system and its binary components.

26731 (UCRL-JC–111304) **Quantitative HREM study of the atomic structure of the Σ(310)/[001] symmetric tilt grain boundary in Nb.** King, W.E.; Campbell, G.H. Lawrence Livermore National Lab., CA (United States). Nov 1992. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-921101–121: 16. Material Research Society international symposium on the scientific basis for nuclear waste management fall meeting, Boston, MA (United States), 30 Nov - 5 dec 1992). Order Number DE93013834. Source: OSTI; NTIS; GPO Dep.

We have used a non-linear least squares optimization method to deduce a model for the atomic structure of the Σ(310)/[001] symmetric tilt grain boundary in Nb from high resolution electron micrographs (HREM) of a bicrystal prepared by diffusion bonding. The resultant model is similar to, but differs in detail from a theoretical prediction based on interatomic potentials which included angular forces thought to be important in the prediction of defect structures in body centered cubic metals. Results validate this approach as a step toward making HREM quantitative technique.

26732 (UCRL-JC–111973) **X-ray dichroism experiments using circular polarization.** Tobin, J.G. (Lawrence Livermore National Lab., CA (United States)); Waddill, G.D.; Sterne, P.A.; Gouder, T.; Jankowski, A.; Pappas, D.P.; Webb, D.J. Lawrence Livermore National Lab., CA (United States). Aug 1992. 2p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9208225–1: Advanced light source users meeting, Berkeley, CA (United States), 27-28 Aug 1992). Order Number DE93013195. Source: OSTI; NTIS; GPO Dep.

We report giant circular dichroism in the near-edge core-level x-ray absorption of a near-monolayer metal film. We have performed magnetic circular dichroism experiments on Fe/Cu(001), using both core-level photoemission and near-edge absorption fine structure, as well as photoemission of the exchange split 3s states. Coverage and temperature dependences were investigated. A simple, one electron picture supported by supercell calculations has worked well to explain normalized branching ratio measurements.

26733 (UCRL-JC–112067) **Atomic structure of the (310) twin in niobium: Theoretical predictions and comparison with experimental observation.** Campbell, G.H. (Lawrence Livermore National Lab., CA (United States)); King, W.E.; Foiles, S.M.; Ruehle, M. Lawrence Livermore National Lab., CA (United States). Nov 1992. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-921101–120: 16. Material Research Society international symposium on the scientific basis for nuclear waste management fall meeting, Boston, MA (United States), 30 Nov - 5 dec 1992). Order Number DE93013421. Source: OSTI; NTIS; GPO Dep.

High-resolution transmission electron microscopy (HREM) has been used to characterize the atomic structure of the symmetric 36.9° tilt grain boundary with [001] tilt axes forming a twin about (310) in Nb. The projected structure was imaged along two different directions in the plane of the boundary and was compared to model structures through high-resolution image simulation. The atomic structure of this Σ-5 boundary was predicted with atomistic simulations using interatomic potentials derived from the Embedded Atom Method (EAM), Finnis-Sinclair (FS), and the Model Generalized Pseudopotential Theory (MGPT). The EAM and FS predicted structures with translations of the adjacent crystals which break mirror symmetry. The MGPT predicted one stable structure with mirror symmetry. The atomic structure of the (310) twin in Nb was found by HREM to be mirror symmetric. These findings indicate that the angular dependent interactions modeled in the MGPT are important for determining the grain boundary structures of bcc transition metals.

26734 (WHC-SA–1361) **BAKEOUT: A computer program for predicting diffusive outgassing from stainless steel.** Weis, M.P. Westinghouse Hanford Co., Richland, WA (United States). Dec 1992. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (CONF-930702–24: Pressure vessels and piping conference, Denver, CO (United States), 25-29 Jul 1993). Order Number DE93012613. Source: OSTI; NTIS; GPO Dep.

The outgassing load from a leak-tight and well-baked vacuum vessel is frequently dominated by the diffusive outgassing of hydrogen gas from the materials of which the vessel is constructed. Stainless steel, in particular, can be a major source of hydrogen. The diffusive transport of gas through materials is governed by the second order partial differential equation, $D\ \partial^2C/\partial X^2 = \partial C/\partial t$, known as Fick's Law. Two alternate solutions to this equation give exact numerical answers of the diffusive outgassing rate versus time. A simplified approximation of each solution allows prediction of both the short-term and the long-term behavior. BAKEOUT, a computer program based on Fick's Law, was developed to predict an elevated temperature step function of time (that is, a bakeout) that will achieve a desired hydrogen diffusive outgassing rate from a stainless steel vessel under vacuum. This paper presents the mathematical development of the computer program and an example case.

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Refer also to citation(s) 26626, 26838, 26851, 26947, 27047, 27907, 27930

26735 (ANL/MCT/CP–77789) **Weibull analysis applied to the pull adhesion test and fracture of a metal-ceramic interface.** Erck, R.A. (Argonne National Lab., IL (United States). Materials and Components Technology Div.); Nichols, F.A.; Schult, D.L. Argonne National Lab., IL (United States). Materials and Components Technology Div. Nov 1992. 21p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9304133–1: Annual conference and exhibition of the Society of Tribologists and Lubrication Engineers, Calgary (Canada), 17-20 Apr 1993). Order Number DE93012913. Source: OSTI; NTIS; GPO Dep.

Various adhesion tests have been developed to measure the mechanical bonding of thin coatings deposited on substrates. In the pull test, pins that have been bonded to the coating under test are pulled with increasing force normal to the coating until the coating is pulled from the substrate. For many systems, large scatter in the data is often observed due to uncontrolled defects in the interface and the brittle nature of the pull test. In this study, the applicability of Weibull statistics to the analysis of adhesion of Ag films to vacuum sputter-cleaned zirconia was examined. Data were obtained for smooth and rough substrates for various levels of adhesion. A good fit of the data to the Weibull distribution was observed. The Weibull modulus was found to depend on the roughness of the substrate, but was insensitive to the adhesion strength.

26736 (ANL/MSD/CP–79578) **Roles of oxygen defects in copper-oxide superconductors.** Jorgensen, J.D.; Radaelli, P.G.;

Shaked, H.; Wagner, J.L.; Hunter, B.A.; Mitchell, J.F.; Litterman, R.L.; Hinks, D.G. Argonne National Lab., IL (United States). Apr 1993. 6p. Sponsored by USDOE, Washington, DC (United States); National Science Foundation, Washington, DC (United States). DOE Contract W-31109-ENG-38. Grant DMR-91-20000. (CONF-930682–1: International workshop on superconductivity, Hokkaido (Japan), 28 Jun - 1 jul 1993). Order Number DE93014875. Source: OSTI; NTIS; INIS; GPO Dep.

Oxygen vacancy and interstitial defects can have a profound effect on the superconducting compounds. Recent work on compounds such as La_2CuO_{4+x} new insight into the role of interstitial oxygen defects as a doping mechanism. Studies of $(La,Sr,Ca)_3Cu_2O_{6+x}$ with various metal compositions and metal-site ordering show that interstitial oxygen defects that form between the CuO_2 layers in this structure systematically lower T_c and eventually destroy superconductivity. However, oxygen vacancies in the CuO_2 planes have surprisingly little effect at concentrations below 3%. The infinite-layer compounds, $ACuO_2$ where A=La, Sr, Ca, Nd, etc., in solid-solution combinations, offer a very environment for the formation of interstitial oxygen defects between the CuO_2 planes. However, neutron diffraction experiments on $Sr_{0.9}La_{0.1}CuO_2$ (T_c=42K) have not found any interstitial oxygen.

26737 (CEA-R–5621) **Effect of additives on enhanced sintering and grain growth in uranium dioxide.** Bourgeois, L. CEA Centre d'Etudes de Grenoble, 38 (France). Dept. de Thermohydraulique et de Physique; Institut National Polytechnique, 38 - Grenoble (France). Jun 1992. [144p.] (In French). Order Number DE93630460. Source: OSTI; NTIS (US Sales Only); INIS.

The use of sintering additives has been the most effective way of promoting grain growth of uranium dioxide. We have established a same mechanism for additives which belongs to corundum structure: chromium, aluminium, vanadium and titanium sesquioxides. Study of thermodynamical stabilities of dopants has lead to define suitable sintering atmospheres in order to enhance grain growth. Low solubility limits have been defined at T=1700 deg C for four additives, from variations of final grain size versus initial dopant concentration Identification of second phase after cooling has been done from electronic diffraction patterns. It appears that these solubilities decrease sharply as positive deviation from stoichiometry of uranium dioxide increases. Dilatometric analysis of sintering of doped uranium dioxide has shown in certain cases some enhancement in densification rates, at the point of onset of abnormal grain growth, which is believed to be the source. Nevertheless, the following growth is accompanied with pores coalescence mechanisms and pores entrapment inside grains. Increased thermal stability, during standard annealing, is expected, limiting thereby redensification of nuclear fuel in reactors. Finally, from investigations of additives vaporizations, Al_2O_3 and Cr_2O_3, oxygen exchanges between additives and matrix are believed to occur, which should lead to enhance pore mobility. (Author)., refs., figs., tabs.

26738 (CONF-9208207–2) **Chemical vapor deposition of Ta_2O_5 corrosion resistant coatings.** Graham, D.W.; Stinton, D.P. Oak Ridge National Lab., TN (United States). [1992]. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 1992 coatings for advanced heat engines workshop; Monterey, CA (United States); 2 Aug 1992. Order Number DE93015488. Source: OSTI; NTIS; GPO Dep.

Silicon carbide and silicon nitride heat engine components are susceptible to hot corrosion by molten Na_2SO_4 which forms from impurities present in fuel and the environment. Chemically vapor deposited Ta_2O_5 coatings are being developed as a means to protect components from reaction with these salts and preserve their structural properties. Investigations to optimize the structure of the coating have revealed that the deposition conditions dramatically affect the coating morphology. Coatings deposited at high temperatures are typically columnar in structure; high concentrations of the reactant gases produce oxide powders on the substrate surface. Ta_2O_5 deposited at low temperatures consists of grains that are finer and have significantly less porosity than that formed at high temperatures. Samples of coatings which have been produced by CVD have successfully completed preliminary testing for resistance to corrosion by Na_2SO_4.

26739 (CONF-921101–123) **Fast-ICCD photography and gated photon counting measurements of blackbody emission from particulates generated in the KrF-laser ablation of BN and YBCO.** Geohegan, D.B. Oak Ridge National Lab., TN (United States). Nov 1992. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 16. Material Research Society international symposium on the scientific basis for nuclear waste management fall meeting; Boston, MA (United States); 30 Nov - 5 dec 1992. Order Number DE93015491. Source: OSTI; NTIS; GPO Dep.

Fast intensified CCD photography and gated photon counting following KrF-laser irradiation of YBCO and BN targets reveals the first observations of very weak emission from slow-moving ejecta up to 2 cm from the target and times extending to ≈1.5 ms. Time-of-flight velocities inferred from the emission measurements indicate velocities ($v \sim (0.45–1.2) \times 10^4$ cm s^{-1}) comparable to those measured for the large particles which often accompany the pulsed laser deposition process. Gated photon counting is employed to obtain temporally resolved spectra of this weak emission. The spectral shape is characteristic of blackbody emission, which shifts to longer wavelengths as the particles cool during flight in vacuum. Estimates of the temperature of the particles are made based on the emissivity of a perfect blackbody and range from 2200 K to 3200 K for both BN and YBCO when irradiated at (Φ_{248} = 3.5 J cm^{-2} and 1.5 J cm^{-2}, respectively. The temperature decrease of the particles in vacuum is compared to a radiative cooling model which gives estimates of the initial surface temperature and radii of the particles.

26740 (CONF-921101–126) **Thin Ni silicide formation by low temperature-induced metal atom reaction with ion implanted amorphous silicon.** Erokhin, Yu.N. (North Carolina State Univ., Raleigh, NC (United States). Dept. of Materials Science and Engineering); Pramanick, S.; Hong, F.; Rozgonyi, G.A.; Patnaik, B.K. Oak Ridge National Lab., TN (United States). [1992]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 16. Material Research Society international symposium on the scientific basis for nuclear waste management fall meeting; Boston, MA (United States); 30 Nov - 5 dec 1992. Order Number DE93015449. Source: OSTI; NTIS; INIS; GPO Dep.

We have extended our recent work on buried silicide formation by Ni diffusion into a buried amorphous silicon layer to the case where silicide formation is at lower temperatures on silicon substrates which have been preamorphized. The reaction of metal atoms from a 12 nm Ni film evaporated on top of a 65 nm thick surface amorphous layer formed by 35 keV Si^+ ion implantation has been investigated at temperature $\leq$400C. Rutherford Backscattering Spectrometry (RBS) with channeling, cross-sectional transmission electron microscopy (XTEM), x-ray diffraction and four-point-probe measurements were used to determine structure, interfacial morphology, composition and resistivity of the silicide films. It has been found that an increased rate of silicidation occurs for amorphous silicon with respect to crystalline areas permitting a selective control of the silicon area to be contacted during silicide growth. Vacuum furnace annealing at 360C for 8 hours followed by an additional step at 400C for one hour produces a continuos $NiSi_2$ layer with a resistivity 44 $\mu\Omega$ cm.

26741 (CONF-921101–129) **Kinetics of photodeposition of superconducting films.** Chen, C.H. (Oak Ridge National Lab., TN (United States)); Phillips, R.C.; Morrison, P.W. Oak Ridge National Lab., TN (United States). [1992]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 16. Material Research Society international symposium on the scientific basis for nuclear waste management fall meeting; Boston, MA (United States); 30 Nov - 5 dec 1992. Order Number DE93015511. Source: OSTI; NTIS; GPO Dep.

It is critical to understand the kinetics of photodeposition of metal-oxide superconducting films. The monitoring of surface conditions of superconducting films on substrates was primarily obtained by FTIR. Desorbed ions and neutral atoms are the primary species producing the films during the laser ablation process, and mass spectroscopy is effective for determining the desorbed species. Although efforts have been made to learn the process, no

complete models have been arrived at. In general, the production of superconducting films is primarily due to deposition of neutral atoms and metal oxide molecules. 10 figs, 6 refs, 1 tab.

26742 (CONF-921101–131) **The influence of microstructure on the mechanical behavior of silicon nitride ceramics.** Becher, P.F. (Oak Ridge National Lab., TN (United States)); Lin, H.T.; Hwang, S.L.; Hoffmann, M.J.; Chen, I-Wei. Oak Ridge National Lab., TN (United States). [1992]. 12p. Sponsored by USDOE, Washington, DC (United States); Department of Defense, Washington, DC (United States); German Federal Ministry of Science and Technology (Germany). DOE Contract AC05-84OR21400. Grant AF0SR-91-0094;Grant 03M2012. From 16. Material Research Society international symposium on the scientific basis for nuclear waste management fall meeting; Boston, MA (United States); 30 Nov - 5 dec 1992. Order Number DE93015363. Source: OSTI; NTIS; GPO Dep.

Elongated Si nitride grains produced during densification in a liquid phase can increase the fracture toughness, but this depends on the activation of intergranular rather than transgranular fracture. Bridging in the crack wake by elongated grains and pullout of some of these grains suggest that the crack wake mechanisms that contribute to toughening of whisker-reinforced ceramics can also operate in Si nitrides containing elongated grains. With diameters of the larger elongated grains approaching 9 μm, strengths > 800 MPa have been achieved along with Weibull moduli, but clustering of these larger elongated grains must be avoided. Fatigue of these toughened Si nitrides is influenced by silicate grain boundary phases. Design of toughened Si nitrides must consider effects of silicate phase composition and content on fatigue and creep. 8 figs, 18 refs.

26743 (CONF-921101–133) **Rheology and microstructure of concentrated zirconia-alumina suspensions for gelcasting composites.** Bleier, A.; Omatete, O.O. Oak Ridge National Lab., TN (United States). [1992]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 16. Material Research Society international symposium on the scientific basis for nuclear waste management fall meeting; Boston, MA (United States); 30 Nov - 5 dec 1992. Order Number DE93015339. Source: OSTI; NTIS; GPO Dep.

The relations among colloidal stability, suspension rheology, and solids loading are elucidated for zirconia-alumina mixtures containing 20 volt ZrO_2, based on solids. The lower colloidal stability of ZrO_2 limits the rheological properties of this system. If the zeta potential of ZrO_2 is less than 49 mV, high degrees of pseudoplasticity, high yield stress, high viscosity, and long relaxation times characterize the binary suspensions. These effects occur, despite the fact that ZrO_2 is the minor ceramic constituent. If the zeta potential of ZrO_2 is maintained above 49 mV, suspensions with high solids loading (55 vol%) can be prepared which behave as Newtonian fluids over the 0-to-200 s-1 shear rate range and as an elastic solid at higher rates. As the solids loading of a highly stable binary suspension is increased, the rheological properties change. They evolve from those of a near Newtonian-like fluid with nearly independent particles (40 vol%) to those of a pseudoplastic fluid with a weakly interacting particle network (50 vol%) to those of an elastic-like solid composed of crowded, strongly repulsive particles (55 vol%). Low-shear conditions for suspension-transport and mold-filling operations that ensure a homogeneous arrangement of ZrO_2 and Al_2O_3 particles in a gelcast ceramic seem promising.

26744 (CONF-9211101–11) **Development of a constitutive model for creep and life prediction of advanced silicon nitride ceramics.** Ding, J.L. (Washington State Univ., Pullman, WA (US)); Liu, K.C.; Brinkman, C.R. Oak Ridge National Lab., TN (United States). [1992]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Annual automotive development technology contractors' coordination meeting; Dearborn, MI (United States); 2-5 Nov 1992. Order Number DE93015894. Source: OSTI; NTIS; GPO Dep.

A constitutive model capable of describing deformation and predicting rupture life was developed for high temperature ceramic materials under general thermal-mechanical loading conditions. The model was developed based on the deformation and fracture behavior observed from a systematic experimental study on an advanced silicon nitride (Si_3N_4) ceramic material. Validity of the model was evaluated with reference to creep and creep rupture data obtained under constant and stepwise-varied loading conditions, including the effects of annealing on creep and creep rupture behavior.

26745 (CONF-930164–11) **Multiaxial deformation and life prediction model and experimental data for advanced silicon nitride ceramics.** Ding, J.L. (Washington State Univ., Pullman, WA (United States). Dept. of Mechanical and Materials Engineering); Liu, K.C.; Brinkman, C.R. Oak Ridge National Lab., TN (United States). [1993]. 48p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 17. annual conference on composites and advanced ceramics; Cocoa Beach, FL (United States); 11-15 Jan 1993. Order Number DE93015450. Source: OSTI; NTIS; GPO Dep.

This paper summarizes recent experimental results on creep and creep rupture behavior of a commercial grade of Si_3N_4 ceramic in the temperature range of 1150 to 1300C obtained at ORNL; and introduces a tentative multiaxial deformation and life prediction model for ceramic materials under general thermomechanical loadings. Issues related to the possible standardization of the data analysis methodology and possible future research needs for high temperature structural ceramics in the area of development of data base and life prediction methodology are also discussed.

26746 (CONF-930438–24) **Crystallization of grain boundary phases in silicon nitride with low additive contents by microwave annealing.** Tiegs, T.N. (Oak Ridge National Lab., TN (United States)); Ploetz, K.L.; Kiggans, J.O.; Yeckley, R.L. Oak Ridge National Lab., TN (United States). [1993]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 95. annual meeting of the American Ceramic Society; Cincinnati, OH (United States); 18-22 Apr 1993. Order Number DE93015801. Source: OSTI; NTIS; GPO Dep.

Microwave annealing of dense Si_3N_4-4% Y_2O_3 materials showed improvements over conventional heating. Increases in fracture toughness were observed for annealing between 1200–1650C. The high temperature strength was related to the residual α-Si_3N_4 content which is indicative of a finer average grain size in the specimens. The high temperature dynamic fatigue showed increased stress to failure for specimens microwave annealed between 1400–1550C for periods >5 h. Silicon nitrides with different sintering additives would require different conditions for optimum crystallization. While there were some observed property improvements, they were not so dramatic to justify abandoning conventional over microwave heating. The Si_3N_4-4% Y_2O_3 materials used in the study were developed for elevated temperature use and already posses excellent good high temperature strength, fatigue resistance and creep properties. This is due to the very refractory nature of the grain boundary phases and the small quantity of secondary phase present. However, microwave annealing of these materials may be necessary in applications where the maximum in fracture toughness and fatigue resistance are required and thus justifies its use.

26747 (CONF-9304144–4) **Effects of depositon rate on $Bi_2Sr_2CaCu_2O_{8+x}$ and $Bi_2Sr_{1.6}La_{0.4}CuO_{6+x}$ epitaxial thin film growth by pulsed-laser ablation.** Zhu, S. (Tennessee Univ., Knoxville, TN (United States). Dept. of Physics and Astronomy); Lowndes, D.H.; Chakoumakos, B.C.; Christen, D.K.; Budai, J.D.; Zheng, X.Y.; Warmack, R.J. Oak Ridge National Lab., TN (United States). [1993]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 2. international conference on laser ablation; Knoxville, TN (United States); 19-22 Apr 1993. Order Number DE93015797. Source: OSTI; NTIS; GPO Dep.

$Bi_2Sr_2CaCu_2O_{8+x}$ and $Bi_2Sr_{1.6}La_{0.4}CuO_{6+x}$ epitaxial films have been grown on (001) MgO and $SrTiO_3$ substrates at different deposition rates by pulsed-laser ablation(PLA). Surface morphology, crystallinity and superconducting critical temperature of the films depend sensitively on deposition rate even though ablation target composition and substrate temperature were kept almost constant. Scanning election microscopy showed that density of particles generated by PLA is reduced by decreasing the deposition rate. Results show that the highest quality films of the highly anisotropic

Bi-based materials are deposited by PLA at a low deposition rate, which results in film growth in a near-equilibrium state. 9 refs, 1 tab, 3 figs.

26748 (CONF-930682–2) **High-resolution Z-contrast imaging and hole concentration mapping of YBCO thin films.** Pennycook, S.J.; Browning, N.D.: Chisholm, M.F.; Zhu, S.; Feenstra, R.; Norton, D.P.; Lowndes, D.H. Oak Ridge National Lab., TN (United States). May 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From International workshop on superconductivity; Hokkaido (Japan); 28 Jun - 1 jul 1993. Order Number DE93015803. Source: OSTI; NTIS; INIS; GPO Dep.

Atomic-resolution Z-contrast electron microscopy provides a directly interpretable image showing the location of high-Z atomic columns without the need for any structural models. Usually, the type of column may be identified from its intensity, and the structure and morphology of interfaces, ultrathin films, and superlattices are directly revealed. This has generated many insights into growth and relaxation phenomena. Since the Z-contrast image uses only electrons scattered through large angles, electron energy loss spectroscopy may be performed simultaneously using the transmitted beam, providing information on the local hole concentration from the fine structure of the oxygen-K absorption edge. The resolution achieved is below the coherence length, allowing a microscopic interpretation of transport properties. 7 figs, 14 refs.

26749 (DOE/ER/12128–1) **Combustion synthesis and engineering of nanoparticles for electronic, structural and superconductor applications: Annual progress report, December 1, 1992–May 31, 1993.** Stangle, G.C.; Amarakoon, V.R.W.; Schulze, W.A. State Univ. of New York, Alfred, NY (United States). Coll. of Ceramics. 28 May 1993. 21p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-93ER12128. Order Number DE93016286. Source: OSTI; NTIS; GPO Dep.

Fully dense, nanocrystalline ceramic articles were prepared by the new nanofabrication process. The process consists of two steps: synthesis of ceramic nanoparticles and fabrication of dense, nanocrystalline ceramic parts. The synthesis step produced 10-nanometer-diameter crystallites, and is capable of being scaled up to kilogram/hour production rates. The fabrication step produced dense parts at significantly reduced sintering temperatures and times – representing a factor of 10–100 reduction in process energy requirements. The process was demonstrated by producing ultrafine-grained yttria-stabilized ZrO_2, an important material with a variety of energy-related applications (solid electrolytes, oxygen sensors, electrode materials, thermal barrier coatings, etc.). Results from this period clearly illustrate the capabilities of this energy-efficient and directly commercializable process for producing dense, nanocrystalline, multicomponent oxide ceramics.

26750 (DOE/ER/45249–T2) **Summary report of research accomplishments.** Munir, Z.A. California Univ., Davis, CA (United States). Dept. of Mechanical, Aeronautical and Materials Engineering. Apr 1992. 23p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG03-86ER45249. Order Number DE93016296. Source: OSTI; NTIS; GPO Dep.

Recent work dealing with combustion synthesis of ceramics, metallics, and composites, is summarized. Research was carried out to investigate the mechanism of synthesis in simple (nitrides and silicides, particularly TiN), composite (TiC + NiAl), and solid solutions (TiNC). 17 figs.

26751 (DOE/ER/45391–4) **Theory of the electronic and structural properties of solid state oxides: Annual technical report 1993.** Chelikowsky, J.R. Minnesota Univ., Minneapolis, MN (United States). Dept. of Chemical Engineering and Materials Science. [1993]. 34p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-89ER45391. Order Number DE93016051. Source: OSTI; NTIS; GPO Dep.

Emphasis has been on the electronic materials: silica, titania, and ruthenia. Fundamental interest centered on nature of microstructure of these solids in the amorphous state, or mixed oxide state. New theoretical techniques have been implemented to examine such issues, based on ab initio pseudopotential methods and interatomic potentials. Some areas examined under this project are: (1) Nature of the amorphization transformation of quartz under pressure. Specific focus is on the microscopic nature of the amorphous material and the driving forces for amorphization. (2) Equation of states of crystalline silica polymorphs. (3) Elastic anomalies in silica. In particular, the existence of a "negative" Poisson ratio in high temperature, low density forms of crystalline silica. (4) Optical and structural properties of titania and mixed oxides such as $Ru_xTi_{1-x}O_2$.

26752 (DOE/ER/45431–3) **First-principles studies of phase stability and the structural and dynamical properties of hydrogen-metal systems: Final report.** Chou, M.Y. Georgia Inst. of Tech., Atlanta, GA (United States). School of Physics. May 1993. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-90ER45431. Order Number DE93016129. Source: OSTI; NTIS; INIS; GPO Dep.

First-principles calculations were carried for the hydrogen-yttrium system using the pseudopotential method within the local density functional approximation (LDA). We have studied the nature of hydrogen pairing in the solid solution phase (α-YH_x) and identified the connection with electronic structure. The vibrational spectra, diffusion barrier, and migration path were also investigated. We have also studied the binding characteristics for different interstitial sites and the (420)-plane ordering of octahedral hydrogen in βYH_{2+x} within the lattice gas model. Temperature-composition phase diagram was calculated by cluster variational method with the multibody interactions extracted from total energies of related ordered structures. Moreover, the discovery of Peierls distortions in YH_3 explained the unusual hydrogen displacements found in neutron diffraction and the possibility of an excitonic insulating ground state was speculated. Several new improvements in the calculational techniques also been developed: Separable nonlocal pseudopotentials, scheme to calculate the full phonon spectrum, and distance dependent tight-binding parameters. The Ru(0001)-H system was also studied.

26753 (INIS-BR–3122) **Determination of thermodynamic properties and stability limit from fluorite phase of uranium and lanthanide mixed oxides, using galvanic cells with solid electrolytes.** Santiago, T.N. Pernambuco Univ., Recife, PE (Brazil). Dept. de Energia Nuclear. Oct 1980. [59p.] (In Portuguese). Order Number DE93629207. Source: OSTI; NTIS (US Sales Only); INIS.

A method for thermodynamic properties determination for oxygen solubility in oxide systems at temperature interval $973 \leq T\ [K] \leq 1773$ is described. A galvanic cell using as solid electrolytes zircon dioxide doped with 15% of calcium oxide is presented. This method was used for determining the phase change, temperature dependent, of uranium-lanthanides-oxygen Ln U O_4 stoichiometric system. (C.G.C.).

26754 (JINR-R–17-91-340) **Oxygen diffusion in $YBa_2Cu_3O_{6+\delta}$ ceramics on heating.** Balagurov, A.M.; Vuong, N.V.; Kuan, Ch.A.; Kui, L.K.; Chieu, F.K. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Neutron Physics. 1991. [10p.] (In Russian). Order Number DE93629161. Source: OSTI; NTIS (US Sales Only); INIS.

The oxygen diffusion in $YBa_2Cu_3O_{6+\delta}$-ceramics by heating the samples from room temperature to 350 deg C with constant rate v=0.5, 1, 2 and 3 deg C/min was investigated. It has been shown, that the oxygen uptake in initial sample $YBa_2Cu_3O_6$ can be described by the one-dimensional diffusion model. The diffusion coefficient in the tetra-phase at $T \leq 500$ deg C is confirmed to be $D(cm^2/sec)=(0.84\text{-}3.4)x10^{-4}$ exp (-0.6 eV/KT). 18 refs.; 2 figs.; 2 tabs.

26755 (JINR-R–17-91-341) **Description of oxygen diffusion in $YBa_2Cu_3O_{6+\delta}$ ceramics.** Vuong, N.V. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Neutron Physics. 1991. [10p.] (In Russian). Order Number DE93629191. Source: OSTI; NTIS (US Sales Only); INIS.

The one-dimension diffusion model of oxygen uptakes in $YBa_2Cu_3O_{6+\delta}$-ceramics has been presented. The calculated results were compared with experimental data. The oxygen diffusion coefficient has been estimated for temperatures 150-700 deg C and oxygen partial pressures 1.4-10.7 atm. 14 refs.; 2 figs.; 1 tab.

26756 (JINR-R-17-91-342) **Influence of the granular surface on the oxygen uptake in $YBa_2Cu_3O_{6+\delta}$ ceramics.** Vuong, N.V.; Tuong, V.Kh.; Kui, L.K.; Chieu, F.K. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Neutron Physics. 1991. [6p.] (In Russian). Order Number DE93629162. Source: OSTI; NTIS (US Sales Only); INIS.

It is proposed the method of 'hot grinding' for the quick oxygen uptake in $YBa_2Cu_3O_x$. The oxygen content in the initial sample $YBa_2Cu_3O_{6.1}$ after grinding at 350 deg C in air for 15 min was increased to 6.88 and the limit value of x=6.97 was obtained by this way for 300 min. 5 refs.; 2 figs.; 1 tab.

26757 (LA-UR–93-1282) **Plastic anisotropy in $MoSi_2$ single crystals.** Mitchell, T.E.; Maloy, S.A. Los Alamos National Lab., NM (United States). [1993]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9303161–1: Critical issues in the development of high temperature structural materials meeting, Kona (Japan), 8-12 Mar 1993). Order Number DE93012650. Source: OSTI; NTIS; GPO Dep.

Single crystals Of $MoSi_2$ are an order of magnitude stronger when compressed along [001] than along any other orientation. This is because the easy slip systems, <101><100> and <110><111>, have a zero Schmid factor acting on them so that harder slip systems are forced into operation. We find that [001] crystals compressed at 1OOOC yield by slip on <103><331>. TEM shows that the 1/2<331> dislocations tend to decompose into 1/2<111> and <110> dislocations. This decomposition process apparently inhibits the mobility of 1/2<331> dislocations at higher temperatures and another system, <101><1ll>, becomes operative at 1300C and above. [021] crystals have been tested for comparison and are found to yield at much lower stresses on the easy systems. In the design of advanced high temperature structural materials based on $MOSi_2$, the large plastic anisotropy should be used to advantage.

26758 (LA-UR–93-1285) **A thermokinetic model describing the vaporization behavior of $U_xZr_{1-x}C_{1-y}$ in hydrogen.** Butt, D.P. Los Alamos National Lab., NM (United States). [1993]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930103–35: 10. symposium on space nuclear power and propulsion, Albuquerque, NM (United States), 10-14 Jan 1993). Order Number DE93012649. Source: OSTI; NTIS; GPO Dep.

This paper describes the thermodynamics and kinetics of the corrosion of $U_xZr_{1-x}C_{1-y}$ in hydrogen gas. It describes how corrosion rates are influenced by variables such as pressure, temperature, and gas flow rate. A model is developed which agrees with experimental steady-state corrosion rates at 1 atm between 2670 and 3100 K. It is shown that under steady-state conditions the corrosion flux is rate limited by the vapor phase transport of Zr(g) away from the solid surface to the bulk gas stream where the partial pressure of Zr(g) is determined by the congruently vaporizing surface composition. Extrapolation of the model to higher pressures indicates that Zr(g) transport should also be rate limiting at higher pressures but the corrosion rate should decrease slightly with increased hydrogen pressure due to reduced gaseous diffusion rates. The model predicts that the corrosion rate will increase as the square root of gas velocity for a given temperature and pressure. Calculations demonstrating the effects of gas velocity are in agreement with experimental studies.

26759 (LA-UR–93-1306) **Microwave hybrid heating of alumina filaments.** Vogt, G.J.; Unruh, W.P. Los Alamos National Lab., NM (United States). [1993]. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930438–9: 95. annual meeting of the American Ceramic Society, Cincinnati, OH (United States), 18-22 Apr 1993). Order Number DE93012642. Source: OSTI; NTIS; GPO Dep.

Low loss oxide ceramics filaments are not readily heated to sintering temperatures (>900°C) by direct microwave heating at 2.45 GHz. Use of high power levels typically yields thermal runaway with catastrophic melting. In other studies, hybrid, or indirect, heating has been successfully applied to processing bulk oxide ceramics. In this work, commercial alumina-based filaments have been indirectly heated to 700°–900°C through a lossy carbon coating on the filament tow. Specific filaments can reach higher temperatures by direct coupling after preheating with a lossy coating. The results of microwave hybrid heating in a single mode TE_{102} cavity will be described for commercial alumina-based filaments.

26760 (LA-UR–93-1456) **Microwave sintering of large alumina bodies.** Blake, R.D.; Katz, J.D. Los Alamos National Lab., NM (United States). [1993]. 9p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930438–6: 95. annual meeting of the American Ceramic Society, Cincinnati, OH (United States), 18-22 Apr 1993). Order Number DE93012752. Source: OSTI; NTIS; GPO Dep.

The application of microwaves as an energy source for materials processing of large alumina bodies at elevated temperatures has been limited to date. Most work has concerned itself with small laboratory samples. The nonuniformity of the microwave field within a cavity subjects large alumina bodies to areas of concentrated energy, resulting in uneven heating and subsequent cracking. Smaller bodies are not significantly affected by field nonuniformity due to their smaller mass. This work will demonstrate a method for microwave sintering of large alumina bodies while maintaining their structural integrity. Several alumina configurations were successfully sintered using a method which creates an artificial field or environment within the microwave cavity.

26761 (LA-UR–93-1518) **Synthesis of ceramic oxide powders in a microwave plasma device.** Vollath, D.; Sickafus, K.E. Los Alamos National Lab., NM (United States). [1993]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930927–1: 3. conference of the European Ceramic Society, Madrid (Spain), 13-17 Sep 1993). Order Number DE93012741. Source: OSTI; NTIS; GPO Dep.

Synthesizing oxide ceramic powders by application of a microwave plasma is of great advantage. The microwave plasma can be used two ways: To act as a source of heat for the pyrolysis of solutions and to excite gas phase reactions to obtain nanosized powders. Both applications are superior to standard methods. A microwave cavity well suited for these experiments and its operating characteristics are described. Using a microwave plasma as a source of heat for pyrolytic decomposition of nitrates in aqueous solutions leads to a fine grained product with particle sizes from 100 to 1000 nm. Crystallite sizes in those particles are in most cases less than 10 nm. This is demonstrated with zirconia-based ceramics, such as ZrO_2 – 3m% Y_2O_3 – 20m% Al_2O_3, Depending on conditions during pyrolysis, it is possible to obtain a product in which alumina is either dissolved in zirconia or the onset of the phase separation is observed. Energy efficiency for this process is better than 80%. If the reactants are gaseous e.g., $ZrCl_4$ it is possible to produce powders with mean crystallite sizes of about 4 nm. In the case of zirconia these particles are nanocrystalline with a cubic structure. This structure is not in equilibrium under the experimental conditions.

26762 (LA-UR–93-1705) **Measurement of penetration depth $\lambda(T)$ in $YBa_2Cu_3O_{7-\delta}$ thin film.** Lee, J.Y. (Ohio State Univ., Columbus, OH (United States). Dept. of Physics); Lemberger, T.R.; Foltyn, S.; Wu, X.D. Los Alamos National Lab., NM (United States). [1993]. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930801–2: Conference of the International Union of Pure and Applied Physics on low temperature physics (LT 20), Eugene, OR (United States), 1-11 Aug 1993). Order Number DE93014587. Source: OSTI; NTIS; GPO Dep.

We present the magnetic penetration depth $\lambda(T)$ in two laser ablated $YBa_2Cu_3O_{7-\delta}$ thin films, determined by the two-coil method. The slope of $1/\lambda^2(T)$ near T_c, the only exactly measurable quantity, extrapolates to 930Å at T=0, which compares well with 830Å in the high quality single crystal recently reported by Hardy et al., and which exhibited a linear T dependence at low T. For $T < 30K$, we find $\lambda(T)/\lambda(0)-1 = a(T/T_c)^2$ where a=0.5.

26763 (LBL–33971) **Direct submillimeter absorptivity measurements on epitaxial $Ba_{1-x}K_xBiO_3$films at 2K.** Miller, D. (Lawrence Berkeley Lab., CA (United States)); Richards, P.L.; Nicol, E.J.; Hellman, E.S.; Hartford, E.H. Jr.; Platt, C.E.; Schweinfurth, R.A.; VanHarlingen, D.J.; Amano, J. Lawrence Berkeley Lab.,

CA (United States). Apr 1993. 4p. Sponsored by USDOE, Washington, DC (United States); National Science Foundation, Washington, DC (United States). DOE Contract AC03-76SF00098. Grant: STC-90-09854. (CONF-930367–5: Conference on spectroscopies in novel superconductors, Santa Fe, NM (United States), 17-19 Mar 1993). Order Number DE93013904. Source: OSTI; NTIS; INIS; GPO Dep.

We have used a bolometric technique to obtain accurate low temperature loss data for epitaxial thin films of $Ba_{0.6}K_{0.4}BiO_3$ from 30 to 700 cm^{-1}. These films were grown on MgO and $SrTiO_3$ substrates by MBE, off-axis sputtering and laser deposition techniques. All films show a strong absorption onset near the BCS tunneling gap of $3.5k_BT_c$. We have analyzed these data using a Kramers-Kronig transformation and have corrected for finite film thickness effects. Results indicate that the absorption onset is consistent with a superconducting energy gap. Comparison is made with predictions based on strong coupling Eliashberg theory using $\alpha^2F(\omega)$ spectra obtained from the literature. While we are able to fit the overall measured absorptivity, we are unable to fit the structure observed in our data.

26764 (LNS–169) **Neutron spectroscopic investigations on crystalline-electric-field and exchange interactions on high-Tc superconductors.** Staub, U. Eidgenoessische Technische Hochschule, Zurich (Switzerland). May 1993. [141p.] (In German). Order Number DE93630537. Source: OSTI; NTIS; INIS.

Diss. ETH Nr. 10161.

It is well known that in the high temperature superconductors of the type $RBa_2Cu_3O_x$(123), with R=Y and most of the rare earths, superconductivity is believed to be controlled by the density of mobile charges in the copper oxide (CuO_2) planes. In particular, the charge transfer process from the chains to the planes seems to play an important role. In the 123, $RBa_2Cu_4O_8$ (1248) and the $Bi_2Sr_2Ca_{1-x}Ho_xCu_2O_{8+\delta}$ (Bi2212) systems, the R ions are sandwiched between the CuO_2 planes, thus the crystalline electric field (CEF) interaction at the R sites constitutes an ideal probe of the local symmetry and the charge distribution of the superconducting planes. The (2J+1)-fold degeneracy of the ground-state J-multiplet of the rare earth ions will be partially lifted under the action of the CEF potential. By means of inelastic neutron scattering experiments it is possible to observe directly the transitions between the CEF states. Therefrom we obtain useful information on both the structure and the charge distribution in the vicinity of the R ion. In order to quantify the charge transfer process from the chains to the planes, we performed a detailed analysis of the CEF of Ho^{3+} in the 123, 1248 and Bi2212 systems. In addition, we present some experiments on a Cl doped 123 sample and some external pressure experiments on the 123 system. In nearly all high-T_c compounds $RBa_2Cu_3O_{7-\delta}$ superconductivity and magnetic ordering of the R ion sublattice coexist at low temperatures. In order to understand the interplay of magnetism and superconductivity in these systems, information on both the electronic ground state of the R^{3+} ions and the coupling mechanisms between the R^{3+} ions is highly desirable. (author) figs., tabs., 73 refs.

26765 (ORNL/FTR–4381) **Travel to Germany to attend the international conference on defects in insulating materials: Foreign trip report, August 14–31, 1992.** Chen, Yok. Oak Ridge National Lab., TN (United States). 29 Sep 1992. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93012414. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The traveler attended the International Conference on Defects in Insulating Materials (ICDIM) in Nordkirchen, Germany, to present two papers and visited the Universidad Carlos III in Madrid, Spain for collaborative research.

26766 (ORNL/TM–12375, pp. 110-124) **Formalization of an ontology of ceramic science in Classic.** Speel, P.H. (Univ. of Twente, Enschede (NL)); Vet, P.E. van der; Stal, W. ter; Mars, N.J.I. Oak Ridge National Lab., TN (United States). May 1993. (CONF-9306151–: 7. international symposium on methodologies for intelligent systems, Trondheim (Norway), 15-18 Jun 1993). In *Proceedings of the Seventh International Symposium on Methodologies for Intelligent Systems (Poster Session).* 174p. Order Number DE93013470. Source: OSTI; NTIS.

Recently, the term "ontology" has become popular in the field of (artificial intelligence) AI. However, often confusion arises when one is attempting to relate an ontology to existing AI subjects. It is argued that an ontology (i) is situated within the conceptualization stage of knowledge-based system (KBS) development methods, (ii) specifies the domain on which logic-based knowledge representation (KR) languages are defined semantically, and (iii) represents the terminological/description (and not the assertional) component. The authors have developed an ontology for a subdomain of materials science, called ceramic science. The ontology has been formalized and implemented in the CLASSIC KR language to allow its use within the Plinius project. (The aim of the Plinius project is to build a system which is able to semi-automatically extract knowledge from natural-language texts concerning ceramics.) In this paper, the authors first concentrate on the integration of the three previously mentioned AI subjects and the face of an ontology in this integrated whole. Then, they focus on both the syntactical and semantical formalization of the Plinius ontology in the CLASSIC KR language. It is argued that the semantics of the formulae need to be defined in order to guarantee the correctness of these formulae with respect to a model which includes the Plinius ontology. 29 refs., 2 figs.

26767 (PNL–8622) **Fabrication of advanced design (grooved) cermet anodes.** Windisch, C.F. Jr. (Pacific Northwest Lab., Richland, WA (United States)); Huettig, F.R. Pacific Northwest Lab., Richland, WA (United States). May 1993. 54p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93014590. Source: OSTI; NTIS; GPO Dep.

Attempts were made to fabricate full-size anodes with advanced, or grooved, design using isostatic pressing, slip casting injection molding. Of the three approaches, isostatic pressing produced an anode with dimensions nearest to the target specifications, without serious macroscopic flaws. This approach is considered the most promising for making advanced anodes for aluminum smelting. However, significant work still remains to optimize the physical properties and microstructure of the anode, both of which were significantly different from that of previous anodes. Injection molding and slip casting yielded anode materials with serious deficiencies, including cracks and holes. Injection molding gave cermet material with the best intrinsic microstructure, i.e., the microstructure of the material between macroscopic flaws was very similar to that of anodes previously made at PNL. Reason for the similarity may have to do with amount of residual binder in the material prior to sintering.

26768 (RISO-R–628(EN), pp. 189) **Organic superconductors.** Bechgaard, K. (University of Copenhagen (Denmark)). Risoe National Lab., Roskilde (Denmark). Physics Dept. May 1992. (CONF-9205342–: Joint Nordic spring meeting '92; 3. Nordic conference on surface science; 6. Nordic symposium on computer simulation; 3. Nordic symposium on superconductivity, Nyborg (Denmark), 7-10 May 1992). In *Proceedings of the joint Nordic spring meeting '92.* [346p.] Order Number DE93624440. Source: OSTI; NTIS; INIS.

Short communication. ORGANIC SUPERCONDUCTORS/ molecular structure; PHYSICAL PROPERTIES; TMTSF; TRANSITION TEMPERATURE

26769 (SAND–92-2490C) **Solution chemistry optimization of sol-gel processed PZT thin films.** Lockwood, S.J. Schwartz, R.W.; Tuttle, B.A.; Thomas, E.V. Sandia National Labs., Albuquerque, NM (United States). [1992]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9305195–1: 1993 Spring meeting of the Materials Research Society (MRS), San Francisco, CA (United States), 12-16 May 1993). Order Number DE93013776. Source: OSTI; NTIS; GPO Dep.

We have optimized the ferroelectric properties and microstructural characteristics of sol-gel PZT thin films used in a CMOS-integrated, 256 bit ferroelectric non-volatile memory. The sol-gel process utilized in our work involved the reaction of Zr n-butoxide, Ti isopropoxide, and Pb (IV) acetate in a methanol/acetic acid solvent system. A 10-factor screening experiment identified solution concentration, acetic acid addition, and water volume as

the solution chemistry factors having the most significant effects on the remanent polarization, coercive field, ferroelectric loop quality, and microstructural quality. The optimal values for these factors were determined by running a 3-factor uniform shell design, modeling the responses, and testing the models at the predicted optimal conditions. The optimized solution chemistry generated 3-layer, 300–400 nm thick films on RuO_2 coated silicon substrates with coercive fields of less than 25 kv/cm (a 40–50% improvement over the original solution chemistry), a remanent polarization of 25–30 μC/cm, and a reduction in the pyrochlore phase content below observable levels.

26770 (SAND–93-1068C) **Problems and opportunities in microwave joining of ceramics.** Loehman, R.E. Sandia National Labs., Albuquerque, NM (United States). [1993]. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-930438–23: 95. annual meeting of the American Ceramic Society, Cincinnati, OH (United States), 18-22 Apr 1993). Order Number DE93014998. Source: OSTI; NTIS; GPO Dep.

This document reviews briefly ceramic joining and considers some aspects relevant to heating using microwave energy. It is concluded that the general applicability of microwave heating for ceramic joining has yet to be demonstrated. There are particular applications, such as joining of SiC to itself, that may hold promise. However, more work needs to be done.

3606 Other Materials

Refer also to citation(s) 25550, 25608, 25679, 25733, 25746, 25750, 25755, 25788, 25816, 25823, 25833, 25998, 26515, 26743, 26765, 26836, 26851, 26869, 26870, 26874, 26910, 26912, 26945, 26955, 26956, 26959, 27048, 27064, 27171, 27179, 27182, 27214, 27222, 27931, 28051, 28138

26771 (ANL/MCT/CP–78063) **Mechanical properties of magnesium ammonium phosphate cements and their zeolite composites.** Wagh, A.S.; Singh, D.; Subhan, W.; Chawla, N. Argonne National Lab., IL (United States). Materials and Components Technology Div. Apr 1993. 23p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-930438–21: 95. annual meeting of the American Ceramic Society, Cincinnati, OH (United States), 18-22 Apr 1993). Order Number DE93015155. Source: OSTI; NTIS; GPO Dep.

Phosphate-bonded cements have been proposed as candidates for solidification and stabilization of mixed wastes. Magnesium ammonium phosphate (MAP) has been investigated as a candidate material. Detailed physical and mechanical properties of MAP cement are reported. It is synthesized by the route of reaction of calcined MgO and ammonium phosphate solution. Samples are made by setting the cement at room temperature and slight pressure. The porosity is reduced to ~11% by impregnation of ammonium phosphate solution. Detailed mechanical properties such as flexural strength, fracture toughness and compression strength are reported and fracture mechanical analyses supported with scanning electron microscopy are provided. Properties of composites of these cements with zeolites, which may be used for containment of radioactive as well as chemical waste are studied. We demonstrate that the strengths of these composites compare well with portland cement even after 50% loading of zeolites. Fracture mechanical implications of such loadings are given.

26772 (ANL/MSD/CP–79640) **de Haas-van Alphen studies and Fermi surface properties of organic superconductors $(ET)_2X$.** Wosnitza, J. (Karlsruhe Univ. (T.H.) (Germany). Physikalisches Inst.); Crabtree, G.W.; Williams, J.M.; Wang, H.H.; Carlson, K.D.; Geiser, U. Argonne National Lab., IL (United States). Apr 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9208132–13: 1992 international conference on science and technology of synthetic metals (ICSM), Goeteborg (Sweden), 12-18 Aug 1992). Order Number DE93015157. Source: OSTI; NTIS; GPO Dep.

de Haas-van Alphen (dHvA) measurements of organic superconductors $(ET)_2X$, where ET stands for bis(ethylene)dithiotetrathiafulvalene (or BEDT-TTF) and X = IBr_2, $(NH_4)Hg(SCN)_4$ and $Cu(NCS)_2$ are reported. The strong two-dimensionality of the Fermi surface (FS) is clearly seen by the perfect $1/\cos(\Theta)$-behavior of the dHvA frequency. The distinctive kind of beating and the angular dependence of the dHvA signal in β-$(ET)_2IBr_2$ gives clear evidence for a lightly corrugated structure of the FS. Due to the nearly cylinder-shape of the FS the bare band structure effective mass, m_b, also shows a $1/\cos(\Theta)$-dependence which is responsible for spin splitting zeros at certain angles. At these points, where the fundamental amplitude of the dHvA signal is vanishing, m_b could exactly be determined and by comparison with the independently measured cyclotron effective mass the electron-phonon coupling constant could be estimated. 17 refs, 5 figs.

26773 (BARC–1992/E/030) **Preparation of synthetic diamond films at sub-atmospheric pressure and their characterisation.** Dua, A.K. (Bhabha Atomic Research Centre, Bombay (India). Chemistry Div.); Pruthi, D.D.; George, V.C.; Raj, P. Bhabha Atomic Research Centre, Bombay (India). 1992. [28p.] Order Number DE93630597. Source: OSTI; NTIS (US Sales Only); INIS.

The salient features of hot filament chemical vapour deposition facility indigenously designed and fabricated are reported. It has been used to deposit high quality diamond on Si(100), Mo, Ta, W, Nb, Zr, Fe, Ni, Cu, stainless steel and alumina substrates. The diamond coatings have been characterised unambiguously using scanning electron microscopy, laser Raman spectroscopy and X ray diffraction technique. It is possible to deposit multilayer, continuous, faceted type polycrystalline films up to 24 μ thick over an area 25x12 mm^2 and at a rate up to 3 μ/hr. (author). 9 refs., 20 figs.

26774 (CONF-920792–61) **Optical and infrared spectra of thermally annealed Pb implanted SiO_2 glasses.** Henderson, D.O. (Fisk Univ., Nashville, TN (United States). Dept. of Physics); Morgan, S.H.; Mu, R.; Magruder, R.H. III; Anderson, T.S.; Wittig, J.E.; Zuhr, R.A. Oak Ridge National Lab., TN (United States). [1992]. 9p. Sponsored by USDOE, Washington, DC (United States); National Aeronautics and Space Administration, Washington, DC (United States); Federal Aviation Administration, Washington, DC (United States). DOE Contract AC05-84OR21400. From 37. annual Society of Photo-Optical Instrumentation Engineers (SPIE) international symposium on optical and optoelectronic applied science and engineering; San Diego, CA (United States); 19-24 Jul 1992. Order Number DE93015304. Source: OSTI; NTIS; GPO Dep.

Infrared reflectance between 4000 and 100 cm^{-1} and optical spectra between 1.8 and 6.2 eV of high purity silica implanted with nominal doses of 1, 3 and 6 x 10^{16} Pb ions/cm^2 were recorded before and after annealing at 400, 600, and 800C for 1 hour. Curve resolution analysis of the Si-O stretching region resulted in six peaks which were characterized by their lineshape parameters. The oscillator strength of the ion induced defect peak at 1035 cm^{-1} was found to depend on ion dose. The defect band at 1035 cm^{-1} decreased to an intensity comparable to that of the unimplanted glass after thermal annealing for 1 hour at 800C. Far infrared spectra indicated the formation of lead silicate particles after annealing.

26775 (CONF-9209253–5) **Scintillation mechanism in stoichiometric cerium compounds.** Wojtowicz, A.J. (Boston Univ., MA (United States). Dept. of Chemistry); Lempicki, A.; Berman, E. Boston Univ., MA (United States). Dept. of Chemistry; ALEM Associates, Boston, MA (United States). [1992]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-90ER61033 ;FG02-92ER81360. From Crystal 2000 international workshop on heavy scintillators for scientific and industrial applications; Chamonix (France); 22-26 Sep 1992. Order Number DE93015499. Source: OSTI; NTIS; INIS; GPO Dep.

These materials constitute a new class of scintillator media, with high speed and high light output. This is illustrated using CeF_3, and CeP_5O_{14}. While speed, being limited by a radiative lifetime of an allowed d-f transition on the Ce^{+3} ion, cannot be improved (without loss of the light output), the light output in both cases falls significantly below the estimated theoretical limit. To explain this we propose a mechanism of scintillation process, in which transfer of excitation energy from the lattice to the d-f electronic structure of Ce^{+3} ions is absent and the light output of the scintillator is limited to the excitation energy directly intercepted by Ce ions. The efficiency depends, therefore, on the competition for holes between

Ce^{+3} ions and anions, determining the share of the total energy deposited by a high energy particle, which can be transformed into scintillation photons. The mechanism requires that the Ce ion has a stable 4+ charge state. Ionization of Ce^{+3} is followed by capturing of an electron and creation of the Ce bound exciton. In the next step the energy of the bound exciton is transferred to the d-f structure of the Ce ion and, in the final step, a scintillation photon is emitted. The relatively high light output characteristic of these materials is due to the high concentration of Ce ions. The reasons for the lack of efficient energy transfer from the lattice may reside in large relaxation energies of lattice excitations. We use this model to discuss potential improvements in the light output of CeF_3.

26776 (CONF-921101–130) **Lattice site of helium implanted in Si and diamond.** Allen, W.R. Oak Ridge National Lab., TN (United States). [1992]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 16. Material Research Society international symposium on the scientific basis for nuclear waste management fall meeting; Boston, MA (United States); 30 Nov - 5 dec 1992. Order Number DE93015365. Source: OSTI; NTIS; GPO Dep.

Single crystals of silicon and diamond were implanted at 300K with 70 keV ^{3}He. Ion channeling analyses were executed by application of Rutherford backscattering spectrometry and nuclear reaction analysis. Helium exhibits a non-random lattice site in the channeling angular distributions for silicon and diamond. A major fraction of the implanted ^{3}He was qualitatively identified to be near to the tetrahedral interstice in both materials. However, greater occupation of tetrahedral interstices was noted in Si.

26777 (CONF-921206–13) **Structural investigation of electrochemically etched silicon.** Heuser, B.J. (Missouri Univ., Columbia, MO (United States). Research Reactor Facility); Spooner, S.; Glinka, C.J.; Gilliam, D.L.; Winslow, N.A.; Boley, M.S. Oak Ridge National Lab., TN (United States). [1992]. 4p. Sponsored by USDOE, Washington, DC (United States); National Science Foundation, Washington, DC (United States). DOE Contract AC05-84OR21400. Grant DMR91224444. From Materials Research Society (MRS) symposium; Boston, MA (United States); 2-6 Dec 1992. Order Number DE93015300. Source: OSTI; NTIS; GPO Dep.

Small-angle neutron scattering, (SANS) measurements of four electrochemically etched, porous (PS) samples have been performed over a wide wavevector transfer (Q) range. The intermediate to high Q results can be modeled with a non-particulate, random phase model. Correlation length scales on the order of 1 to 2 nm thought to characterize the PS skeleton have been deduced from the SANS data. The microstructural anisotropy was studied by tilting two of the samples with respect to the neutron beam. These samples exhibited an asymmetric scattering pattern at intermediate $Q(0.1 \leq Q \leq 0.6\ nm^{-1}$ in this condition. Photoluminescence spectra from all four samples have been recorded as well. A correlation appears to exist between the SANS and photoluminescence measurements. An x-ray diffraction measurement of one sample demonstrates that the PS layer retains the silicon lattice structure. Significant peak broadening is observed and is interpreted as a quasi-particle size effect. The PS particle size calculated from the x-ray diffraction measurement is equal to the correlation length obtained in the SANS measurement.

26778 (CONF-930164–12) **Modeling the thermal conductivity of fiber-reinforced ceramic composites.** Beecher, S.C.; Dinwiddie, R.B. Oak Ridge National Lab., TN (United States). [1993]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 17. annual conference on composites and advanced ceramics; Cocoa Beach, FL (United States); 11-15 Jan 1993. Order Number DE93015340. Source: OSTI; NTIS; GPO Dep.

A review of models for the prediction of the thermal conductivity of uni-directional fiber-reinforced composites will be presented. The ability of these models to give an accurate prediction of the composite thermal conductivity depends on the amount of information known about the constituent phase properties under the assumption that these properties do not change as a result of processing. Also presented are models that take into account the effects of fiber coatings.

26779 (CONF-930318–10) **Corrosion kinetics and mechanisms for nuclear grade graphites.** Fuller, L.E. Jr.; Kopp, O.C.; Underwood, A.D. Oak Ridge National Lab., TN (United States). [1993]. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From NACE annual corrosion conference and materials performance and corrosion show; New Orleans, LA (United States); 7-12 Mar 1993. Order Number DE93015462. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report is an initial microgravimetric evaluation of the intrinsic reaction parameters for air reactions with H-451 graphite at 375 to 850C at atmospheric pressure and for water contents from 0 to 2 vol% water vapor. Photography show heterogeneous nature of the graphite and consequential variation of reaction rate as the samples are etched and roughened in the corrosion processes. The reaction rate increases approximately two fold to a near-constant value and subsequently approaches zero as the remnant skeletal matrix is consumed. There appears to be no significant rate effect (neither catalytic nor impedimental) due to the presence of water vapor in the concentrations used.

26780 (CONF-9304144–3) **Negative ion formation in small carbon clusters.** Carman, H.S. Jr.; Compton, R.N. Oak Ridge National Lab., TN (United States). [1993]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 2. international conference on laser ablation; Knoxville, TN (United States); 19-22 Apr 1993. Order Number DE93015436. Source: OSTI; NTIS; GPO Dep.

Laser ablation of graphite into a rare gas supersonic jet has been used to generate C_m clusters (both neutral and ionic) in the size range $m \leq 30$. Negative ions produced by three different mechanisms have been studied: (1) ion formation during the ablation process, (2) low energy electron attachment (Rydberg electron transfer) to neutral clusters, and (3) charge transfer from ground state rubidium atoms to neutral clusters. The C_m^- distributions observed for the three cases are distinctly different, providing insights into the structures, stabilities, and electron attachment dynamics of small carbon clusters.

26781 (CONF-9306183–1) **Insights into semiconducting materials and growth phenomena through Z-contrast STEM.** Pennycook, S.J.; Jesson, D.E.; Chisholm, M.F.; Browning, N.D. Oak Ridge National Lab., TN (United States). Apr 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 20. annual meeting of the Microscopical Society of Canada (MSC); Toronto (Canada); 2-5 Jun 1993. Order Number DE93015964. Source: OSTI; NTIS; GPO Dep.

The high-angle annular detector proposed by Howie is used to form an atomic-resolution Z-contrast image in a high-resolution scanning transmission electron microscope. For incoherent scattering, the coherent probe is effectively channeled along each individual atomic column, forming a basis for atomic-resolution incoherent imaging and atomic-resolution microanalysis. Incoherent imaging is combined with strong compositional sensitivity. Since a model structure is not needed to interpret the images to first order, unexpected interfacial phenomena are immediately apparent, such as the compositional ordering at a $CoSi_2$/Si(100) interface made by high-dose Co implantation and annealing. Growth and relaxation of strained Si_xGe_{1-x} layers are studied. Combining atomic-resolution imaging and analysis on a single microscope is a powerful method for studying interfaces without any prior knowledge or model structures. 7 figs, 19 refs.

26782 (CONF-930961–2) **Overview of chemical vapor infiltration.** Besmann, T.M.; Stinton, D.P.; Lowden, R.A. Oak Ridge National Lab., TN (United States). [1993]. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From International conference on high temperature ceramic matrix composites; Bordeaux (France); 20-25 Sep 1993. Order Number DE93015440. Source: OSTI; NTIS; GPO Dep.

chemical vapor infiltration (CVI) is developing into a commercially important method for the fabrication of continuous filament ceramic composites. Current efforts are focused on the development of an improved understanding of the various processes in CVI and its modeling. New approaches to CVI are being explored, including

pressure pulse infiltration and microwave heating. Material development is also proceeding with emphasis on improving the oxidation resistance of the interfacial layer between the fiber and matrix. This paper briefly reviews these subjects, indicating the current state of the science and technology.

26783 (CONF-9309149–1) **Nextel™/SiC composites fabricated using forced chemical vapor infiltration.** Weaver, B.L. (3M Co., St. Paul, MN (United States)); Lowden, R.A.; McLaughlin, J.C.; Stinton, D.P.; Besmann, T.M.; Schwarz, O.J. Oak Ridge National Lab., TN (United States). [1993]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From HTCMC meeting; No City Given (France); 20-23 Sep 1993. Order Number DE93013532. Source: OSTI; NTIS; GPO Dep.

Oxide fiber-reinforced silicon carbide matrix composites were fabricated employing the forced-flow, thermal gradient chemical vapor infiltration (FCVI) process. Composites using Nextel™ fibers of varying composition were prepared to investigate the effectiveness of each Nextel™ fiber as a reinforcement for the given matrix. A carbon interface coating was used for the baseline materials, however, alternate interlayers with improved oxidation resistance were also explored Room-temperature flexure strengths of as-fabricated composites and specimens heated in air at 1273 K were measured and compared to results for other SiC-matrix composites.

26784 (DOE/ER/14275–1) **[Transport properties of disordered porous media from the microstructure]: Progress report, March 1989–June 1993.** Princeton Univ., NJ (United States). [1993]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-92ER14275. Order Number DE93016065. Source: OSTI; NTIS; GPO Dep.

Progress was made in 4 general areas: quantitative characterization of microstructure via n-point distribution functions; determination of bounds on effective properties that depend on these n-point functions (conductivity, NMR, permeability); derivation of cross- property relations; and development of efficient first-passage time algorithms (Brownian-motion simulations) to compute effective diffusion properties.

26785 (DOE/ER/45237–7) **[Phase transition in polymer blends and structure of ionomers and copolymers]: [Annual report, April 1, 1989–June 30, 1993].** State Univ. of New York, Stony Brook, NY (United States). Dept. of Chemistry. [1993]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-86ER45237. Order Number DE93016256. Source: OSTI; NTIS; GPO Dep.

The main thrust of the program in the past 3 years are summarized: SAXS instrumentation development; structure and dynamics of macro- and supra-molecules, phase transitions in polymer blends and solutions, structure of ionomers, and fractals and anisotropic systems.

26786 (DOE/ER/45298–9) **Synthesis and properties of novel cluster phases: Progress report, [June 30, 1993].** DiSalvo, F. Cornell Univ., Ithaca, NY (United States). Dept. of Chemistry. 15 Jan 1993. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-87ER45298. Order Number DE93017056. Source: OSTI; NTIS; GPO Dep.

The research was in the area of solid cluster compounds containing metal clusters. Two classes of materials were studied: those based on solutions formed by dissolving $LiMo_3Se_3$ in polar solvents, and those based on M_6X_8 clusters. The cluster phases were synthesized and their properties examined. Nb_6I_{11} and Mo_6X_8 were also studied.

26787 (DOE/ER/45362–3) **Stabilization of high T_c superconductivity in cadmium sulfide: Final report.** MacCrone, R.K.; Nettel, S.J. Rensselaer Polytechnic Inst., Troy, NY (United States). [1991]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-88ER45362. Order Number DE93017019. Source: OSTI; NTIS; GPO Dep.

Progress was in two areas, materials preparation (Cl-doped CdS) and theory (anomalous paramagnetism/diamagnetism).

26788 (DOE/ER/45438–3) **Computer simulations for the adsorption of polymers onto surfaces: Progress report.** Balazs, A.C. Pittsburgh Univ., PA (United States). [1993]. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-90ER45438. Order Number DE93016667. Source: OSTI; NTIS; GPO Dep.

Polymer-surface interactions are important in every stage of oil and coal production, production of new energy-efficient composite materials, and in medicine. Therefore, it is important to isolate the factors that influence the interfacial activity of polymer chains. We developed theoretical models and computer simulations to determine effects of polymer architecture, solvent quality, and surface morphology on properties of chains at penetrable and impenetrable interfaces. 7 figs, 27 refs.

26789 (DOE/FTR–93012413) **[Travel to the UK concerning semiconductor research]: Foreign trip report, 16 July–4 August 1992.** Dawson, L.R. Sandia National Labs., Albuquerque, NM (United States). 24 Aug 1992. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93012413. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Dr. Dawson presented an invited paper on the subject of "Applications of Narrow Gap Strained Layer Superlattices" at the 6th International conference on Narrow Gap Semiconductors held at the University of Southampton, Southampton, UK, on July 19–23, 1992. The attendance at this conference was approximately 175, principally from the UK and Europe. Approximately 140 papers were presented in the areas of growth, characterization, and theoretical aspects of a wide range of narrow energy gap semiconductor materials. Results from several of the more important papers are summarized.

26790 (DOE/OR/22014–1) **Failure models in continuous fiber ceramic composites: Phase 1, Task 1, State of the art survey: Continuous fiber ceramic composites program, Task 2, Supporting technologies.** Ostertag, C.P. (National Inst. of Standards and Technology, Gaithersburg, MD (United States)). National Inst. of Standards and Technology, Gaithersburg, MD (United States); Martin Marietta Energy Systems, Inc., Oak Ridge, TN (United States). [1991]. 37p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AI05-92OR22014 ;AC05-84OR21400. Order Number DE93016669. Source: OSTI; NTIS; GPO Dep.

The high toughness of continuous fiber reinforced composites (CFCCs) is due to increasing the thoughness by one or more of the following mechanisms: crack deflection, crack branching, crack bridging, microcracking, or fiber pullout. Most of the toughness, however, is attributed to work required to elastically elongate the bridging fibers and to pull the broken fibers out of the matrix. Understanding of matrix cracking mechanisms is important to the use of CFCCs. This survey concentrates on matrix cracking models established thus far that are based on continuous fiber-reinforced ceramic matrix composites with respect to both matrix crack initiation and matrix crack propagation. A review of experimental results relating material properties to the failure characteristics is included. 75 refs, 4 figs.

26791 (DOE/PC/91305–6) **Characterization of porosity via secondary reactions: Quarterly technical progress report, 1 January 1993–31 March 1993.** Calo, J.M.; Lu, W.; Zhang, L. Brown Univ., Providence, RI (United States). Div. of Engineering. [1993]. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-91PC91305. Order Number DE93016697. Source: OSTI; NTIS; GPO Dep.

Temperature-programmed desorption spectra from steam-gasified chars were examined. At least two major CO-liberating features were identified for the resin char samples, one centered 1000 C and the other 1050 C. Presence of catalytic mineral matter appears to be related to the appearance of an additional low temperature feature for the Wyodak char. Although total amount of surface oxygen seems to be a gross indicator of reactivity, analysis of the desorption data assuming two different types of oxygen surface complexes, each exhibiting a single desorption activation energy, shows that the reactivity cannot be explained by the desorption rates of the complexes alone. 6 figs, 4 tabs, 9 refs.

26792 (EGG–10617-2186) **Growth of single crystals of mercuric iodide on the ground and in space.** van den Berg, L. EG

and G Energy Measurements, Inc., Goleta, CA (United States). Santa Barbara Operations. [1993]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC08-88NV10617. (CONF-930405–21: Spring meeting of the Materials Research Society, San Francisco, CA (United States), 12-16 Apr 1993). Order Number DE93015523. Source: OSTI; NTIS; GPO Dep.

A short review is given of the methods by which mercuric iodide is prepared and purified to obtain material suitable for the growth of single crystals. Method used in our laboratory to grow single crystals up to 1,000 grams in weight from the vapor is discussed. Effects of gravity on the growth process are described. A crystal growth system suitable for operation in the reduced gravity environment of space has been designed and crystal growth experiments have been performed during the flights of Spacelab 3 (April 1985) and the International Microgravity Laboratory (January 1992). Structural quality and electronic properties of ground-based and space-grown crystals are compared.

26793 (ENEA-RT-INN–91-27) **Composite Si/C/N powder production by laser induced gas phase reactions.** Borsella, E.; Botti, S.; Fantoni, R.; Alexandrescu, R.; Morjan, I.; Popescu, C.; Dikonimos-Makris, T.; Giorgi, R.; Enzo, S. ENEA, Frascati (Italy). Dipt. Sviluppo Tecnologie di Punta; ENEA, Casaccia (Italy). Area Energia e Innovazione; Guam Office of Consumer Services, Agana (Guam). Aug 1991. 30p. (RT/INN–91-27). Order Number DE93799221. Source: OSTI; NTIS (US Sales Only).

Ultrafine amorphous Si/C/N ternary powders were prepared in a CO_2 laser assisted process. This paper demonstrates the possibility of driving the C/N ratio the powder by properly choosing the experimental conditions and the gaseous reactant ratio in the initial mixture containing silane, dimethylamine and ammonia. A kinetic model which accounts for reaching the equilibrium between the gaseous reaction intermediates and the solid products is proposed.

26794 (ENEA-RT-INN–91-40) **F center-molecular ion couples in alkali halides: Magneto-optics study (part two). Spin lattice relaxation time and electron spin memory.** Baldacchini, G.; Botti, S.; Grassano, U.M.; Luty, F. ENEA, Frascati (Italy). Dipt. Sviluppo Tecnologie di Punta; Rome Univ. II (Italy). Dipt. di Fisica; Utah Univ., Salt Lake City, UT (United States). Dept. of Physics. Oct 1991. 46p. (In Italian). (RT/INN–91-40). Order Number DE93799296. Source: OSTI; NTIS (US Sales Only); INIS.

The spin-lattice relaxation time in the ground state, T_1, and the spin-mixing parameter during the optical cycle, epsilon, were measured in FH(OH) and FH(CN) centers in various alkali halides (KCl, KBr, KI, CsCl, and CsBr). For a close comparison, all experiments were performed before and after the optical association of the F center and molecular ion. T_1 becomes shorter before and still more after aggregation with respect to the values measured in the pure crystal, especially at very low magnetic fields. Epsilon decreases a little in crystals doped with OH-, while it increases a lot in crystals doped with CN-. Part of these results can be interpreted within the actual knowledge of the F-center physics. Part have been used to shed some light on the various unknown aspects of the energy transfer between the excited F-center and the molecular ion.

26795 (ETDE-IT–93-176) **ArF laser deposited tin oxide films studied by 'in situ' surface analysis techniques.** Larciprete, R.; Borsella, E.; De Padova, P.; Fanfoni, M.; Mangiatini, M.; Perfetti, P. ENEA, Frascati (Italy); Consiglio Nazionale delle Ricerche, Frascati (Italy); Rome Univ. II (Italy). Dipt. di Fisica. 1992. 8p. (CONF-9209307–2: International workshop on laser deposition of advanced materials, Tito (Italy), 28-30 Sep 1992). Order Number DE93799195. Source: OSTI; NTIS (US Sales Only).

Tin oxide films were deposited by ArF excimer laser induced photolysis of $Sn(CH_3)_4O_2$ mixtures. The 'in situ' Auger analysis technique was used to determine the effect of the gas phase O_2 concentration on the film composition. Synchrotron radiation induced UV photoemission spectroscopy was used to investigate the stoichiometry of films deposited irradiating $Sn(CH_3)_4$ diluted in large excess of oxygen. The samples were transferred to the synchrotron radiation facility without any exposure to air and kept in dynamical high vacuum. The results obtained showed that the valence band spectrum was characteristic for SnO_2 and that the 4d Sn core peak did not have any contribution due to metallic tin. The presence of oxygen vacancies was indicated by the weak emission in the band gap region; however, by tuning the synchrotron radiation wavelength, it was noted that these defects were localized at the sample surface.

26796 (INIS-mf–13537) **Pretreatment of industrial phosphoric acid by Algerian filter-aids.** Mellah, A. (Centre de Developpement des Materiaux, Algiers (Algeria)); Setti, Louisa; Chegrouche, Salah. Secretariat d'Etat a la Recherche, Algiers (Algeria). Jan 1993. [11p.] (In French). Order Number DE93629234. Source: OSTI; NTIS (US Sales Only); INIS.

The present work involves the filtration of industrial phosphoric acid by different filter-aids such as kieselguhr, celite and bleaching clay. The retention of substances contained in wet phosphoric acid was determined using the three filter-aids. Thus, the phosphoric acid, obtained by filtration on kieselguhr has the same specifications as technical phosphoric acid produced by Rhone-Poulenc (France) as standard.

26797 (INIS-mf–13546, pp. 86-91) **X-ray effects and swelling of some non-metallic materials after neutron irradiations.** Kosenkov, V.M. (Nauchno-Issledovatel'skij Inst. Atomnykh Reaktorov, Dimitrovgrad (Russian Federation)). AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 7.* [226p.] Order Number DE93630373. Source: OSTI; NTIS (US Sales Only); INIS.

Crystal-chemical aspects of molecular (atomic) volume measured by X-ray method are considered. The volume increase in diamond, beryllium oxide and boron carbide up to 16% is accompanied by appearance of diffusive maximums at X-ray diagrams. There are structural transitions not accompanied by diffraction lines broadening with increase or decrease of molecular volume in double oxide compounds Gd_2O_3 with aluminium, titanium, molybdenum oxides. Vital factor in volume change is establishment of new relations among atoms in the local lattice regions or in the whole crystal volume. 4 refs.; 6 figs. (author).

26798 (INIS-mf–13547, pp. 68-76) **Radiation stability or absorbing compositions with a pyrocarbon binder.** Zelenskij, V.F. (AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. Nizkikh Temperatur); Gurin, V.A.; Konotop, Yu.F.; Kuprienko, V.A.; Samsonov, B.V.; Aksenov, N.A.; Ryakhovskikh, V.I. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 8.* [232p.] Order Number DE93630368. Source: OSTI; NTIS (US Sales Only); INIS.

Various high temperature gas cooled reactor absorbers on the basis of boron carbide prepared by the method of volumetric gas-phase pyrocarbonization of porous media are described in short. The results of radiation tests of absorbing materials are presented. Behaviour of boron carbide absorbers with a pyrocarbon bond under neutron irradiation is discussed. 10 refs.; 4 figs.; 2 tabs. (author).

26799 (INIS-mf–13547, pp. 83-90) **Change of carbon fibre structure and properties under low-temperature neutron irradiation.** Kuznetsov, D.A. (Nauchno-Issledovatel'skij Institut Grafit, Moskva (Russian Federation)); Kurolenkin, E.I.; Virgil'ev, Yu.S.; Kostikov, V.I.; Shevenkova, N.V. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 8.* [232p.] Order Number DE93630368. Source: OSTI; NTIS (US Sales Only); INIS.

The structure and properties of PAN-based carbon fibers (CF) heat-treated in the range of 1600-3100 K neutron irradiated at 340-360 K at fluence up to 4.8×10^{20} n/cm^2 ($E \geq 0.18$ MeV) in an aqueous medium have been investigated. It is shown that the irradiation has resulted in 10-15% increase of the interlayer space and about two-times decrease of the texture X-ray index, as well as in the change of geometric dimensions and density. There occurred the decrease of dynamic modulus by 45%, the increase of strength by 5 times; elastic deformation - by 3 times; electric resistivity -

more than 7 times. An explanation of the effects observed is suggested. 9 refs.; 3 tabs. (author).

26800 (INIS-mf–13547, pp. 91-97) **Irradiation property changes in the structural graphites at 1500-2000^{0}C.** Ashrapov, T.B. (AN Uzbekskoj SSR, Tashkent (Uzbekistan). Inst. Yadernoj Fiziki); Rasulkulov, Kh.M.; Khanbekov, R.G.; Virgil'ev, Yu.S.; Kalyagina, I.P.; Shurshakova, T.N. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 8.* [232p.] Order Number DE93630368. Source: OSTI; NTIS (US Sales Only); INIS.

The results of the irradiation tests at high temperatures (1500 to 2000^{0}C) to fluence near 2x10^{20}n/cm^2 of various kinds of structural graphites (including poor-graphitized ones) are presented. The shrinkage in the order of 0.2% the increase of Young's modulus by 15%, the decrease of resistivity by 10% in graphites (treated to a final temperatures of 2300^{0}C or higher) have been established. The shrinkage by 1% and the intensive decrease of resistivity by 90% in poor-graphitized graphites are interpreted as irradiation induced ordering of a crystalline structure. 3 refs.; 1 fig.; 3 tabs. (author).

26801 (INIS-mf–13547, pp. 197-206) **Radiation damage of boron containing materials.** Bajramashvili, I.A. (Institut Stabil'nykh Izotopov, Tbilisi (Georgia)); Guldamashvili, A.I.; Gogishvili, V.A. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 8.* [232p.] Order Number DE93630368. Source: OSTI; NTIS (US Sales Only); INIS.

Irradiation and testing of high boron-containing materials at room temperature is accompanied by relative decrease of their microhardness. Loosening of crystals irradiated with various ions is associated with the decrease of brittle failure threshold due to the accumulation of radiation defects of interstitial type mainly. When boron, boron carbide and aluminium dodecaboride were irradiated with helium and boron ions of similar ability of target composition change, helium ion with lower displacement rate provided higher loosening effect than boron ion due to formation of highly stable helium - vacancy complexes. 18 refs.; 2 tabs. (author).

26802 (IVO-A–10/92) **Effect of size, shape and end condition of test specimen on compressive strength of high-strength concrete.** Ipatti, A. Imatran Voima Oy (IVO), Helsinki (Finland). 1992. 50p. Order Number DE93500412. Source: OSTI; NTIS.

Compressive testing of high-strength concrete is a critical issue on which no consensus has yet been reached. Among the many factors that are mostly under discussion are the size, shape and end condition of test specimens for high-strength concrete. The experimental program described herein was designed primarily to investigate the effects and the possible interactions of the abovementioned factors on compressive strength of high-strength concrete. Three levels of specimen sizes, three methods of specimen capping (mould surface, sulphur capping, grinding) and four grades of concrete strengths were selected. A 3x3x4 factorial experimental design was adopted with two replicates (each an average of three specimens), giving a total of 72 test values (216 specimen). The strictest possible precautions were taken to ensure that all other factors which would conceivably effect the compressive strength were held constant. The statistical methods utilized included analyses of variance, linear regressions and pairwise comparisons of factor main effects.

26803 (LA-UR–93-1322) **Ceramic matrix composites by microwave assisted CVI.** Currier, R.P.; Devlin, D.J. Los Alamos National Lab., NM (United States). [1993]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930438–14: 95. annual meeting of the American Ceramic Society, Cincinnati, OH (United States), 18-22 Apr 1993). Order Number DE93012640. Source: OSTI; NTIS; GPO Dep.

Chemical vapor infiltration (CVI) processes for producing continuously reinforced ceramic composites are reviewed. The potential advantages of microwave assisted CVI are noted. Recent numerical studies of microwave assisted CVI are then reviewed. These studies predict inverted thermal gradients in fibrous ceramic preforms subjected to microwave radiation and suggest processing strategies for achieving uniformly dense composites. Comparisons are made to experimental results obtained using silicon based composite systems. The importance of microwave-material interactions is stressed. In particular, emphasis is placed on the role played by the relative ability of fiber and matrix to dissipate microwave energy. Results suggest that microwave induced inverted gradients can in fact be exploited using the CVI technique to promote inside-out densification.

26804 (LA-UR–93-1657) **Small-angle scattering, contrast variation and the study of complex composite materials: A study of the structure of carbon black.** Hjelm, R.P. Jr. (Los Alamos National Lab., NM (United States)); Seeger, P.A.; Wampler, W.A. Los Alamos National Lab., NM (United States). [1993]. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9305185–1: American Chemical Society meeting on rubber chemistry and technology, Denver, CO (United States), 18-22 May 1993). Order Number DE93012707. Source: OSTI; NTIS; INIS; GPO Dep.

Detailed studies are presented on the structure and aggregation of an experimental high surface area carbon black (HSA) using small-angle neutron scattering and the method of contrast variation. We find that the approximately 27 mn HSA particle form small, linear aggregates of average aggregation number 5 when suspended in cyclohexane. There is considerable density fluctuation in the interior of these particles, with the denser regions being toward the outer part of the spherically-averaged structure. This information would not have been obtained from studies of carbon black without solvent. The results will be applied to similar scattering studies on solvent-swollen bound rubber gels made from HSA-polyisoprene. These result show, however, that the strong internal fluctuations of the carbon black will limit the information that can be obtained on the structure and conformation of the elastomer in the gel. There are additional limitation from compositional heterogeneity of the sample.

26805 (LA-UR–93-1710) **Dynamic mechanical deformation of a SiC$_p$/Al-Li (8090) composite.** Vaidya, R.U.; Zurek, A.K. Los Alamos National Lab., NM (United States). [1993]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9306167–2: 14. international conference on high pressure science and technology and 1993 technical meeting of the topical group on shock compression of condensed matter, Colorado Springs, CO (United States), 28 Jun - 3 jul 1993). Order Number DE93014586. Source: OSTI; NTIS; GPO Dep.

The deformation behavior in compression of a silicon carbide particle-reinforced aluminum-lithium (8090) matrix composite, at strain rates in the range of 10^{-3} to 6500 s^{-1}, was investigated, and compared with that of unreinforced alloy samples. Dynamics strengthening in these composites was found to change depending on the direction of testing. These differences were attributed to differences in the orientation of the reinforcing particles. 4 refs, 5 figs.

26806 (LA-UR–93-1711) **Measurement of strain in individual phases of composites before, during, and after mechanical loading.** Goldstone, J.A. (Los Alamos National Lab., NM (United States)); Bourke, M.A.M.; Shi, Ning; Lawson, A.C.; Allison, J.E. Los Alamos National Lab., NM (United States). [1993]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9305177–5: 12. International collaboration of advanced neutron sources meeting (ICANS), Abingdon (United Kingdom), 24-28 May 1993). Order Number DE93014585. Source: OSTI; NTIS; GPO Dep.

At LANSCE, we have measured residual strains in a variety of metal-matrix systems using the Neutron Powder Diffractometer (NPD). In 1992, we developed a compact stress rig for in-situ strain measurement during applied loading. Comparison of experimental measurements made with the stress rig on aluminum titanium carbide with numerical predictions showed the importance of including initial thermal residual strains in the models. In Al/TiC, normal to the loading direction, the increase in the average matrix and reinforcement lattice strains was in a "zigzag" manner. Finite element modeling indicated that this resulted from residual strains

induced during cooling from fabrication temperatures. Data and modeling are presented. 16 refs, 5 figs.

26807 (LA-UR–93-1927) **The structure and mechanical properties of Ru-Cu and Ru-Ti nanolayer composites.** Kung, H. (Los Alamos National Lab., NM (United States)); Nastasi, M.; Jervis, T.R.; Hubbard, K.; Mitchell, T.E.; Messner, R.M.; Embury, J.D. Los Alamos National Lab., NM (United States). [1993]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930405–15: Spring meeting of the Materials Research Society, San Francisco, CA (United States), 12-16 Apr 1993). Order Number DE93014453. Source: OSTI; NTIS; GPO Dep.

Multilayers of Ru-Cu and Ru-Ti have been prepared by electron beam evaporation technique. One set of composites has Ru thickness varying from 250 to 2500Å alternating with Cu or Ti of 15Å. The other set has 250Å of Ru and the Cu or Ti layer varies between 15 and 200Å. Nanoindentation measurements show that there is no significant change in hardness as either Ru or Cu/Ti thickness varies. However, the Ru-Cu multilayer has twice the hardness of the Ru-Ti system. The strengthening mechanism proposed by Koehler predicts that Ru-Ti composites would have a higher strength than Ru-Cu due to larger modulus difference between Ru and Ti. Discrepancy between prediction and experiment suggests that other strengthening mechanism(s) may be operating. We have proposed two models based on a "shear" mechanism to explain the differences observed between these two systems. Effects of these mechanisms in controlling the deformation process in nanolayer composites are discussed.

26808 (MHSMP–93-08) **Compatibility testing of vacuum seal materials.** Foster, P.A.; Rodin, W.A. Mason and Hanger-Silas Mason Co., Inc., Amarillo, TX (United States). May 1993. 30p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-91AL65030. Order Number DE93014366. Source: OSTI; NTIS; GPO Dep.

Small scale materials compatibility testing was conducted for three elastomers considered for use as vacuum seal materials; Adiprene MOCAcured, Adiprene Cyanacured, and Sylgard silastic rubber. The tests were conducted using orthogonal array designed experiments for each of the elastomers placed in contact with three materials commonly used during weapon disassembly operations: Duxseal, Sylgard 186 grease, and 2-propyl alcohol. The test results indicated that only the 2-propyl alcohol had a significant effect on the elastomer hardness and physical properties. The alcohol had the largest effect on the two Adiprene materials, with the silastic rubber being the least affected.

26809 (NUTEK-FBT–93-8) **Textile filters for dust separation.** Edberg, B. (Chalmers Univ. of Technology, Gothenburg (Sweden). Dept. of Textile Technology); Stroem, L.; Johansson, B.; Nilsson, R. Swedish National Board for Industrial and Technical Development (NUTEK), Stockholm (Sweden). 1993. 28p. (In Swedish). Project NUTEK-279-498. Order Number DE93500731. Source: OSTI; NTIS.

Needled textile filters have a recognized high separation efficiency. There are still problems concerning availability and service life. Wear and burns occur frequently, probably caused by thermal and mechanical overload, at least locally and temporary. In an attempt to analyse the thermal, mechanical and chemical degradation of the textile filters, the parameter temperature has been studied during operation of a 10 MW power plant, burning wood chips in a fluidized bed. The filter bags were made of meta-aramide fibres, with a base fabric of PTFE. The temperature variations were measured during 110 days. The mechanical properties of new and used filter bags were tested in the laboratory. The natural degradation of the properties was established. By using a load integral the thermal degradation of the strength based on day 65 to 113 was calculated. This resulted in a predicted strength of 89% of new material. Mechanical wear reduced the area weight by about 10%, estimated to give a further strength reduction of the same percentage. The tested diagonal breaking strength was 68%. This indicates that thermal degradation to some extent can be predicted. The obtained data is, however, not sufficient to verify a service life algorithm. Felt swelling and fibre loss are important parameters presently without proper expressions. A study going deeper into filter experience and the ageing properties of polymers, both in theory and practice, would be necessary. (22 figs., 1 tab.).

26810 (OEFZS–4623) **Preliminary experiments for measuring Kd values for cesium and strontium. To be used in site evaluations.** Benischek, I. (Hauptabteilung Entsorgungstechnik, Bereich Umwelt- und Verfahrenstechnik, Forschungszentrum Seibersdorf, Seibersdorf (Austria)); Hess, V.; Metzker, E. Oesterreichisches Forschungszentrum Seibersdorf GmbH (Austria). Mar 1992. [55p.] (In German). Order Number DE93627893. Source: OSTI; NTIS (US Sales Only); INIS.

In an underground dump not only technolgical barriers but also the natural geological formations are efficient in withholding radionuclides. Sites are to be chosen where the rocks have good sorption properties and where transportation due to various chemical interactions should be minimal. Minerals obtained from deep drilling - granodiorite, mylonite and granit gneis - were investigated. The liquid phase (cement leaching water) contained different amounts of cesium 137 and strontium 85. Details of the experiments and results are given.

26811 (OEFZS–4631) **Preliminary experiments for determining Kd values for cesium and strontium as part of site selection. Pt. 2: Experiments with clay materials.** Benischek, I. (Hauptabteilung Entsorgungstechnik, Bereich Umwelt- und Verfahrenstechnik, Forschungszentrum Seibersdorf, Seibersdorf (Austria)); Hess, V.; Metzker, E. Oesterreichisches Forschungszentrum Seibersdorf GmbH (Austria). Jun 1992. [29p.] (In German). Order Number DE93627894. Source: OSTI; NTIS (US Sales Only); INIS.

To obtain Kd values to be used in the safety analyses for radioactive waste dumps experiments were done with clays and bentonite. Cesium and strontium concentrations were varied from 10^{-3}M to 10^{-5}M, temperatures between 20 deg C and 80 deg C. Natural as well as activated bentonites were investigated. Different methods of measuring the cation exchange capacity were applied.

26812 (PNL-SA–21693) **Environmental effects on elevated temperature subcritical crack growth of SIC/SIC composites.** Henager, C.H. Jr.; Jones, R.H. Pacific Northwest Lab., Richland, WA (United States). [1993]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-930317–1: Conference on critical issues in the development of high temperature structural materials, Kona, HI (United States), 7-12 Mar 1993). Order Number DE93015688. Source: OSTI; NTIS; GPO Dep.

Time-dependent crack growth measurements of ceramic composites in varying environments were conducted on materials consisting of chemical vapor infiltrated SiC reinforced with Nicalon fibers having C-interfaces. Crack velocities are determined as a function of applied stress intensity and time for varying O_2 levels. Results are presented for crack velocity/stress intensity relationships in pure Ar and in Ar plus 2000-, 5000-, 10,000-, and 20,000-ppM O_2 atmospheres at 1100C. A 2D micromechanics model is used to represent the time-dependence of observed crack bridging events and to rationalize the observed phenomena.

26813 (SAND–92-2867C) **Characteristics of HEM silicon produced in a reusable crucible.** Khattak, C.P. (Crystal Systems, Inc., Salem, MA (United States)); Schmid, F.; Schubert, W.K.; Cudzinovic, M.; Sopori, B.L. Sandia National Labs., Albuquerque, NM (United States). [1992]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-930540–6: 23. Institute of Electrical and Electronics Engineers (IEEE) photovoltaic specialists conference, Louisville, KY (United States), 10-14 May 1993). Order Number DE93015025. Source: OSTI; NTIS; GPO Dep.

A reusable crucible has been developed for directional solidification of multicrystalline silicon ingots by HEM. Up to five 40 kg, 33 cm square cross section ingots have been produced without visible degradation of the crucible. Characterization of the silicon shows large grain size, vertical orientation of grain boundaries, uniform resistivity, low defect density, diffusion lengths up to 272 μm and less than 1 ppma oxygen concentration. Solar cells of 2 cm x 2 cm size fabricated on 10 cm square wafers have shown good uniformity and efficiencies up to 15.1% and V_{oc} to 616 mV.

26814 (SAND–93-0300C) **The growth of $InAs_{1-x}Sb_x$/InAs strained-layer superlattices by metal-organic chemical vapor deposition.** Biefeld, R.M.; Baucom, K.C.; Kurtz, S.R. Sandia National Labs., Albuquerque, NM (United States). [1993]. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-930851–1: 9. American conference on crystal growth: crystal growth, characterization and applications, Baltimore, MD (United States), 1-6 Aug 1993). Order Number DE93015028. Source: OSTI; NTIS; GPO Dep.

$InAs_{1-x}Sb_x$/InAs strained-layer superlattice (SLS) semiconductors and thick epitaxial layers of $InAs_{1-x}Sb_x$ were grown under a variety of conditions by metal-organic chemical vapor deposition on InAs substrates. The III/V ratio was varied from 0.026 to 1.0 over a temperature range of 475–525C, at pressures of 200 to 660 torr and growth rates of 0.75 to 3.0 μm/hour. The composition of the ternary can be predicted from the input gas molar flow rates using a thermodynamic model. At lower temperatures, the thermodynamic model must be modified to take account of the incomplete decomposition of arsine and trimethylantimony. These layers were characterized by optical microscopy, SIMS, and x-ray diffraction. The optical properties of these SLS's were determined by infrared photoluminescence and absorption measurements. The PL peak energies of the alloys' and the SLS's are consistently lower than the previously reported values for the bandgap of $InAs_{1-x}Sb_x$ alloys.

26815 (SAND–93-0304C, pp. 2, Paper 3) **Interface configurations of $Al_xGa_{1-x}As$/GaAs quantum wells probed by photoluminescence spectroscopy.** Schubert, E.F.; Kopf, R.F.; Harris, R.D. Sandia National Labs., Albuquerque, NM (United States). [1993]. (CONF-921101–108: 16. Material Research Society international symposium on the scientific basis for nuclear waste management fall meeting, Boston, MA (United States), 30 Nov - 5 dec 1992). In *Interface roughness: What is it and how is it measured?*. 35p. Order Number DE93009797. Source: OSTI; NTIS.

Low-temperature photoluminescence measurements have been widely used to probe interface configurations in III-V semiconductor quantum well structures, including the $Al_xGa_{1-x}As$/GaAs material system. This presentation describes how these photoluminescence measurements are performed. The authors also address the question of the length-scale of the optical probe. Experimental evidence and comparisons with experimental results from other techniques are given in support of their arguments.

26816 (SAND–93-0304C, pp. 5, Paper 4) **Roughness at chemical heterointerfaces: Definition and measurement.** Ourmazd, A.; Warwick, C.A. Sandia National Labs., Albuquerque, NM (United States). [1993]. DOE Contract AC04-76DP00789. Contract AFOSR-90-0140;Contract F-49620-91-C-0009. (CONF-921101–108: 16. Material Research Society international symposium on the scientific basis for nuclear waste management fall meeting, Boston, MA (United States), 30 Nov - 5 dec 1992). In *Interface roughness: What is it and how is it measured?*. 35p. Order Number DE93009797. Source: OSTI; NTIS.

Heterointerfaces are complex two-dimensional objects, with undulations on many length scales. Interfaces are best described in terms of roughness spectra, specifying the amount of roughness at each length scale. This discussion is restricted to "chemical"heterointerfaces, such as GaAs/AlAs, across which only the composition changes. Although qualitative data on roughness at heterointerfaces exists, quantitative correlations are largely absent. This presentation briefly outlines how the properties of interfaces may be determined experimentally.

26817 (SAND–93-0725C) **A multiphase model for shock-induced flow in low density foam.** Baer, M.R. Sandia National Labs., Albuquerque, NM (United States). [1993]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-930788–1: 19. international symposium on shock waves, Marseille (France), 26-30 Jul 1993). Order Number DE93013767. Source: OSTI; NTIS; GPO Dep.

A multiphase mixture model is applied to describe shocked-induced flow in deformable low-density foam. This model includes interphase drag and heat transfer and all phases are treated as compressible. Volume fraction is represented as an independent kinematic variable and the entropy inequality suggests a thermodynamically-admissable evolutionary equation to describe rate-dependent compaction. This multiphase model has been applied to shock tube experiments conducted by B. W. Skews and colleagues in the study of normal shock impingement on a wall-supported low density porous layer. Numerical solution of the multiphase flow equations employs a high resolution adaptive finite element method which accurately resolves contact surfaces and shock interactions. Additional studies are presented in an investigation of the effect of initial gas pressure in the foam layer, the shock interaction on multiple layers of foam and the shock- induced flow in an unsupported foam layer.

26818 (SAND–93-1324C) **Sidewall thermometry perturbations to nonlinear heat transport near the λ transition in ^{4}He.** Duncan, R. (Sandia National Labs., Albuquerque, NM (United States)); Akau, R.; Gianoulakis, S.; Israelsson, U.; Chui, T. Sandia National Labs., Albuquerque, NM (United States). [1993]. 2p. Sponsored by USDOE, Washington, DC (United States); National Aeronautics and Space Administration, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-930801–3: Conference of the International Union of Pure and Applied Physics on low temperature physics (LT 20), Eugene, OR (United States), 1-11 Aug 1993). Order Number DE93014990. Source: OSTI; NTIS; GPO Dep.

The effect of a sidewall thermometry probe on heat transport measurements in liquid ^{4}He very close to the superfluid transition is simulated numerically. The effective thermal position of the probe changes with closeness of approach to the superfluid transition. The radial heat flux induced by the sidewall probe is calculated for specific probe designs.

26819 (SLAC-PUB–6078) **Photoemission study of diamond (100) surface.** Wu, J.; Cao, R.; Yang, X.; Pianetta, P.; Lindau, I. Stanford Linear Accelerator Center, Menlo Park, CA (United States). Mar 1993. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00515. (SLAC/SSRL–0015;CONF-921129–10. 39. national symposium of the American Vacuum Society, Chicago, IL (United States), 9-13 Nov 1992). Order Number DE93015251. Source: OSTI; NTIS; INIS; GPO Dep.

The electronic structure of the diamond C(100)-(2 × 1)/(2 × 2) has been investigated by means of angle-resolved photoelectron spectroscopy for the first time. A surface-related shift has been observed in the C 1s core level spectrum. The surface-state band dispersion was measured along the symmetry axis Γ-J' in the surface Brillouin zone. For $k_{||} = 0$, there is a very pronounced surface state 1.5 eV below Fermi level E_F, and it disperses downwards with increasing $k_{||}$. Near the boundary of the surface Brillouin zone J', we find two states with binding energies of 1.9 and 2.4 eV with respect to E_F.

26820 (SVF–463) **Lower operating temperature in district heating networks - field and laboratory measurements of the properties of cellular concrete insulation.** Molin, J. (ABB VIAK (Sweden)); Nilsson, Ronny. Stiftelsen foer Vaermeteknisk Forskning, Stockholm (Sweden). Dec 1992. 55 p.p. (In Swedish). Order Number DE93500706. Source: OSTI; NTIS.

Efforts by municipal heating authorities to reduce costs for production and distribution of district heating has in several cases caused a decrease of operating temperatures in district heating systems. A reduction of operating temperatures has been assumed to increase the risk of external corrosion of steel pipes in culverts where risks of water intrusion into the culvert is conceivable. In this report the result is given from field measurements of the temperature and the relative humidity (RH) in culvert with cellular concrete as insulation and from the determination of the humidity characteristics of the insulation. The determinations of the humidity characteristics are made in the laboratory. (9 refs., 21 figs., 4 tabs.).

26821 (UCRL-JC–107836) **High strain rate effects for composite materials.** Groves, S.E.; Sanchez, R.J.; Lyon, R.E.; Brown, A.E. Lawrence Livermore National Lab., CA (United States). 16 Apr 1992. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9205232–2: 11. American Society for Testing and Materials (ASTM) symposium on composite materials: testing and design, Pittsburgh, PA (United

States), 4-5 May 1992). Order Number DE93013087. Source: OSTI; NTIS; GPO Dep.

We have been developing the capability to characterize the high strain rate response of continuous fiber polymer composites. The data presented covers strain rates from 0/sec to 3000/sec. A combination of test machines and specimen geometries was investigated. Strain rates from 0–100/sec were generated using conventional and high speed hydraulic test machines. Strain rates from 10–1000/sec were generated using a high energy drop tower, and rates from 1000–3000/sec were generated using a split Hopkinson bar. Strain rates above 100/sec have only been generated for uniaxial compression. Our efforts have primarily focused on developing the high energy drop tower for these purposes. Specimen geometries for compression include tapered cubes, one inch tubes, and solid rods. For tension a smaller 0.5 in. diameter version of our 2.0 in. diameter multiaxial test specimen was developed and has been successfully used at strain rates up to 100 per second. Fixtures were also developed for performing high strain rate shear testing and through thickness penetration studies of composite plates. The objective of these experiments is to develop dynamic material models for use in finite element design tools. This presentation will focus on the methods and results obtained from this study.

26822 (UCRL-JC–111397) **Polished substrate surface and cleaning study for coated optic quality.** Tesar, A. (Lawrence Livermore National Lab., CA (United States)); Eickelberg, W.; Koons, K.; Davis, K. Lawrence Livermore National Lab., CA (United States). Nov 1992. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9211104–9: OPTCON '92: optical fabrication and testing workshop, Boston, MA (United States), 17 Nov 1992). Order Number DE93014116. Source: OSTI; NTIS; GPO Dep.

The optical substrate-coating interface is established by (1) the original polished condition of the substrate; (2) the substrate cleaning process; and (3) the environment of the coating process. The substrate-coating interface affects the coating adhesion properties, is where most coating defects and scatter sites are thought to initiate, and in some instances may control the structure of the coating as it is deposited. Often features appear on an optic after coating which could not be observed after cleaning and prior to coating. Because of the wide variety of possible substrate materials, surface problems, and contaminants, cleaning processes are constantly evolving. Our study has clearly shown that the coating appearance is dependent not only on the cleaning method, but especially on the initial character of the substrate surface.

26823 (UCRL-JC–111977) **A zeroth order statistical model for fracture in rock in compression.** Blair, S.C. (Lawrence Livermore National Lab., CA (United States)); Cook, N.G.W.; Daveler, S.A. Lawrence Livermore National Lab., CA (United States). 6 Oct 1992. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-930644–5: 34. US symposium on rock mechanics, Madison, WI (United States), 27-30 Jun 1993). Order Number DE93009307. Source: OSTI; NTIS; GPO Dep.

Recent advances in computing power and percolation theory have led to the development of new statistical models for the fracture of heterogeneous materials, with promising preliminary results. However, application of these models to the field of rock mechanics has been limited because many of the models developed to date operate in a tensile stress field, whereas most of the rock mechanics applications involve compressive stresses. We have developed a statistical model that allows us to use the theoretical machinery of percolation theory to characterize rock fracture in compression. In this paper we describe a zeroth order model that incorporates disorder in the media due to variations in the shape and strength of individual grains, as well as heterogeneity in the local stress field due to cracks and excavations. We also present results of numerical experiments performed with the model; these were designed to evaluate the fundamental role that various types of disorder play in the fracture of rock.

26824 (UCRL-JC–112379) **The effect of process parameters on the surface finish of plasma polymers.** Letts, S.A.; Cook, R.C.; Welch, P.; McEachern, R.; Fearon, E. Lawrence Livermore National Lab., CA (United States). 9 Dec 1992. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-930304–22: 205. American Chemical Society national meeting, Denver, CO (United States), 28 Mar - 2 apr 1993). Order Number DE93014112. Source: OSTI; NTIS; INIS; GPO Dep.

The surface finish of plasma polymers deposited in an inductively coupled discharge were measured as a function of gas flow rates. Surface finish was measured both optically and by AFM. The process parameters of the plasma polymerization were found to effect the surface finish. The gases used were trans-2- butene and hydrogen for hydrocarbon polymers. For bromocarbon polymers we added ethylbromide. The smoothest hydrocarbon polymer coatings had an RMS surface finish better than 1 nm. Bumps 200 nm high spaced approximately 1 μm apart grew on the surface of bromocarbon coatings when they were exposed to air. The composition of the bumps was found to be NH_4Br by XRD and XPS analysis. We believe that nitrogen (from a small leak or desorption) dissociates in the discharge and reacts with hydrogen to form ammonia. The ammonia then reacts with HBr, a dissociation product of ethylbromide, to form NH_4Br which is dispersed throughout the deposited layer. Humidity facilitates the transport of the NH_4Br to the surface where it crystallizes. Bump growth was prevented by either dry storage or overcoating with 3 μm of hydrocarbon plasma polymer. Alternatively, the bumps could be washed from the surface with water.

26825 (UCRL-JC–112408) **Fracture behavior of vanadium/vanadium silicide in-situ composites.** Strum, M.J.; Henshall, G.A. Lawrence Livermore National Lab., CA (United States). 30 Nov 1992. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-921101–119: 16. Material Research Society international symposium on the scientific basis for nuclear waste management fall meeting, Boston, MA (United States), 30 Nov - 5 dec 1992). Order Number DE93013422. Source: OSTI; NTIS; GPO Dep.

The fracture behavior of V-V_3Si in-situ composite alloys has been evaluated for intermetallic phase fractions of 30, 50, and 70 volume percent. In addition, the mechanical properties of the ductile constituent in these composites have been evaluated from two alloys containing silicon at its solubility-limit in vanadium at the eutectic temperature and at 1400°C. The fracture toughness was found to increase monotonically with increasing volume fraction of ductile phase. Fractography has shown evidence of crack bridging by the vanadium solid solution phase and increased ductility within the composite relative to bulk measurements. The toughness results are compared with predictions based on an existing model of ductile-phase toughening using our measurements of component properties.

26826 (UCRL-JC–112521) **Activation and deactivation of high concentration arsenic with some evidence of precipitation.** Rousseau, P.M. (Stanford Univ., CA (US). Center for Integrated Systems); Griffin, P.B.; Plummer, J.D.; Carey, P.G. Lawrence Livermore National Lab., CA (United States). 29 Dec 1992. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-930571–21: 183. Electrochemical Society meeting, Honolulu, HI (United States), 16-21 May 1993). Order Number DE93016437. Source: OSTI; NTIS; GPO Dep.

Using box-shaped profiles created by laser melt annealing, the authors investigate the kinetics of arsenic activation and deactivation. They find deactivation shows no history effects, which can be consistent either with clustering or precipitation for the cases considered. For activation, they notice it occurs on very short time scales, followed by a slower deactivation process. This is suggestive evidence that at least some precipitation occurs.

26827 (UCRL-JC–112981) **Laser-damage susceptibility of nodular defects in dielectric mirror coatings: AFM measurements and electric-field modeling.** Kozlowski, M.R.; DeFord, J.F.; Staggs, M.C. Lawrence Livermore National Lab., CA (United States). 15 Apr 1993. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9304144–1: 2. international conference on laser ablation, Knoxville, TN

(United States), 19-22 Apr 1993). Order Number DE93014655. Source: OSTI; NTIS; INIS; GPO Dep.

Atomic force microscopy (AFM) and electromagnetic field modeling were used to study the influence of nodular coating defects on laser-induced damage of multilayer dielectric coatings. In studies of HfO_2/SiO_2 mirrors with 1.06 μm illumination, AFM results showed that nodular defects with high dome heights (>0.6 μm) were most susceptible to laser damage. Crater defects, formed by nodules ejected from the coating prior to illumination, were not damaged when illuminated over the same range of fluences. A finite-difference time-domain electromagnetic modeling code was used to study the influence of 3-D nodule defects on the E-field distribution within the interference coating. The modeling results show that En-field enhancements as large as a factor of 4 can be present at the defects. Crater defects, however, result in minimal enhancement of the E-fields within the coating. These modeling results are consistent with the AFM experimental data, indicating that E-field enhancement is a contributing mechanism in defect-dominated laser damage of optical coatings.

26828 (Y/EN–4909) **Large-scale testing of structural clay tile infilled frames.** Flanagan, R.D. (Oak Ridge Y-12 Plant, TN (United States)); Bennett, R.M. Oak Ridge Y-12 Plant, TN (United States). 18 Mar 1993. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OS21400. (CONF-930769–2: 1993 joint Canadian Society of Civil Engineers-American Society of Civil Engineers (CSCE-ASCE) national conference on environmental engineering, Montreal (Canada), 12-14 Jul 1993). Order Number DE93011837. Source: OSTI; NTIS; GPO Dep.

A summary of large-scale cyclic static tests of structural clay tile infilled frames is given. In-plane racking tests examined the effects of varying frame stiffness, varying infill size, infill offset from frame centerline, and single and double wythe infill construction. Out-of-plane tests examined infilled frame response to inertial loadings and inter-story drift loadings. Sequential in-plane and out-of-plane loadings were performed to determine the effects of orthogonal damage and degradation on both strength and stiffness. A combined out-of-plane inertial and in-plane racking test was conducted to investigate the interaction of multi-directional loading. To determine constitutive properties of the infills, prism compression, mortar compression and various unit tile tests were performed.

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25829 (LBL–32387) **[Lawrence Berkeley Laboratory] Chemical Sciences Division annual report 1991.** Lawrence Berkeley Lab., CA (United States). Sep 1992. 83p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. Order Number DE93015260. Source: OSTI; NTIS; GPO Dep.

Summaries are given of research in the following fields: photochemistry of materials in stratosphere, energy transfer and structural studies of molecules on surfaces, laser sources and techniques, crossed molecular beams, molecular interactions, theory of atomic and molecular collision processes, selective photochemistry, photodissociation of free radicals, physical chemistry with emphasis on thermodynamic properties, chemical physics at high photon energies, high-energy atomic physics, atomic physics, high-energy oxidizers and delocalized-electron solids, catalytic hydrogenation of CO, transition metal-catalyzed conversion of CO, NO, H_2, and organic molecules to fuels and petrochemicals, formation of oxyacids of sulfur from SO_2, potentially catalytic and conducting organometallics, actinide chemistry, and molecular thermodynamics for phase equilibria in mixtures. Under exploratory R and D funds, the following are discussed: technical evaluation of beamlines and experimental stations for chemical cynamics applications at the ALS synchrotron, and molecular beam threshold time-of-flight spectroscopy of rare gas atoms. Research on normal and superconducting properties of high-T_c systems is reported under work for others. (DLC)

26830 (UCID–20622-92-2) **Chemistry and materials science progress report: Second half, FY 1992.** Sugihara, T.T. Lawrence Livermore National Lab., CA (United States). Mar 1993. 71p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93014364. Source: OSTI; NTIS; GPO Dep.

The research reported here in summary form was conducted under the auspices of weapons-supporting research (WSR) and laboratory directed R and D. Work funded by WSR is organized into 3 categories: thrust areas, research groups, and a few small projects led by individual investigators. The thrust areas were fundamentals of physics and processing of metals; interfaces, adhesion, and bonding; energetic materials; plutonium research; and synchrotron radiation-based materials science. Separate abstracts have been prepared.

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Refer also to citation(s) 25529, 25613, 25625, 25626, 25627, 25647, 25678, 25711, 25718, 25730, 25739, 25740, 25748, 25778, 25782, 25826, 25827, 25883, 25910, 26401, 26572, 26704, 26781, 26795, 27233, 27245, 27407, 27443, 27448, 27476, 27488, 27867

26831 (ANL/ACL–92/4) **Analytical Chemistry Laboratory progress report for FY 1992.** Green, D.W.; Heinrich, R.R.; Graczyk, D.G.; Lindahl, P.C.; Boparai, A.S.; Bass, D.A. Argonne National Lab., IL (United States). Dec 1992. 60p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. Order Number DE93014902. Source: OSTI; NTIS; INIS; GPO Dep.

The ACL activities covered IFR fuel reprocessing, corium-concrete interactions, environmental samples, wastes, WIPP support, Advanced Photon Source, H-Tc superconductors, EBWR vessel, soils, illegal drug detection, quality control, etc.

26832 (ANL/CHM/CP–75734) **Novel extraction chromatographic materials for the separation and preconcentration of radionuclides.** Dietz, M.L.; Horwitz, E.P.; Chiarizia, R.; Diamond, H. Argonne National Lab., IL (United States). [1992]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-930945–3: International solvent extraction conference (ISEC '93), York (United Kingdom), 9-15 Sep 1993). Order Number DE93002899. Source: OSTI; NTIS; GPO Dep.

New chromatographic methods have been developed to separate and preconcentrate the actinide elements and radiostrontium from a variety of biological and environmental samples. Several of these methods involve the use, in an extraction chromatographic mode, of a chemical system originally devised for the removal of various radionuclides from acidic, high-level nuclear waste solutions. For the isolation of actinides, for example, a solution of the sample in nitric acid is passed through a column containing a solution of CMPO in tributyl phosphate (the basis of the well-known TRUEX process) sorbed on an inert polymeric substrate. Isolation of radiostrontium is accomplished by passing a sample solution, again in nitric acid, through a column containing a polymeric support impregnated with an octanol solution of di-t-butylcyclohexano-18-crown-6 (the basis of the SREX process for strontium removal from nuclear wastes). Sorbed strontium can be eluted with dilute nitric acid and counted via liquid scintillation. A variety of applications of these and other related materials to the analysis of environmental and biological samples are described.

26833 (ANL/ER/CP–77861) **Procurement and execution of PCB analyses: Customer-analyst interactions.** Erickson, M.D. Argonne National Lab., IL (United States). [1993]. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9303123–1: 5. international conference for the remediation of PCB contamination, Houston, TX (United States), 15-16 Mar 1993). Order Number DE93009964. Source: OSTI; NTIS; INIS; GPO Dep.

The practical application of PCB (polychlorinated biphenyl) analyses begins with a request for the analysis and concludes with provision of the requested analysis. The key to successful execution of this iteration is timely, professional communication between the requester and the analyst. Often PCB analyses are not satisfactorily executed, either because the requester failed to give adequate instructions or because the analyst simply "did what he/she was told." The request for and conduct of a PCB analysis represents a contract for the procurement of a product (information

about the sample); if both parties recognize and abide by this contractual relationship, the process generally proceeds smoothly. Requesters may be corporate purchasing agents working from a scope of work, a sample management office, a field team leader, a project manager, a physician's office, or the analyst himself. The analyst with whom the requester communicates may be a laboratory supervisor, a sample-receiving department, a salesperson for the laboratory, or the analyst himself. The analyst conducting the analysis is often a team, with custody of the sample being passed from sample receiving to the extraction laboratory, to the cleanup laboratory, to the gas chromatography (GC) laboratory, to the data reduction person, to the package preparation person, to the quality control (QC) department for verification, to shipping. Where a team of analysts is involved, the requester needs a central point of contact to minimize confusion and frustration. For the requester-analyst interface to work smoothly, it must function as if it is a one-to-one interaction. This article addresses the pitfalls of the requester-analyst interaction and provides suggestions for improving the quality of the analytical product through the requester-analyst interface.

26834 (ANL/MSD/CP–78019) **New techniques for synchrotron powder diffraction studies.** Knapp, G.S.; Beno, M.A.; Jennings, G.; Ramanathan, M. Argonne National Lab., IL (United States). Apr 1993. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-930405–16: Spring meeting of the Materials Research Society, San Francisco, CA (United States), 12-16 Apr 1993). Order Number DE93015136. Source: OSTI; NTIS; INIS; GPO Dep.

This manuscript discusses two different powder diffraction methods which possess high resolution, low background and very high counting rates. Both methods utilize analyzer crystals in combination with position sensitive detectors. The first method uses a curved perfect crystal analyzer diffracting in the scattering plane to diffract a range of angles into the position sensitive detector. The second method is somewhat simpler, it uses a graphite analyzer crystal diffracting out of the scattering plane. Applications of these methods to anomalous scattering from both powder and amorphous materials are also discussed. One of the techniques should also be very useful for small angle scattering.

26835 (BNL–48580) **Monitoring and trace detection of hazardous waste and toxic chemicals using resonance Raman spectroscopy.** Sedlacek, A.J. III; Dougherty, D.R.; Chen, C.L. Brookhaven National Lab., Upton, NY (United States). [1993]. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-930257–4: 3. international symposium of field screening methods for hazardous wastes and toxic chemicals, Las Vegas, NV (United States), 24-26 Feb 1993). Order Number DE93010880. Source: OSTI; NTIS; INIS; GPO Dep.

Raman scattering is a coherent, inelastic, two-photon process, which shifts the frequency of an outgoing photon according to the vibrational structure of the irradiated species, thereby providing a unique fingerprint of the molecule. When involving an allowed electronic transition (resonance Raman), this scattering cross section can be enhanced by 10^4 to 10^6 and provides the basis for a viable technique that can monitor and detect trace quantities of hazardous wastes and toxic chemicals. Resonance Raman spectroscopy (RRS) possesses many of the ideal characteristics for monitoring and detecting of hazardous waste and toxic chemicals. Some of these traits are: (1) very high selectivity (chemical specific fingerprints); (2) independence from the excitation wavelength (ability to monitor in the solar blind region); (3) chemical mixture fingerprints are the sum of its individual components (no spectral cross-talk); (4) near independence of the Raman fingerprint to its physical state (very similar spectra for gas, liquid, solid and solutions – either bulk or aerosols); and (5) insensitivity of the Raman signature to environmental conditions (no quenching). Data from a few chemicals will be presented which illustrate these features. In cases where background fluorescence accompanies the Raman signals, an effective frequency modulation technique has been developed, which can completely eliminate this interference.

26836 (BNL–48887) **Ultra-soft x-ray absorption spectroscopy: A bulk and surface probe of materials.** Fischer, D.A. (National Institute of Standards and Technology, Gaithersburg, MD (United States)); Mitchell, G.E.; Dekoven, B.M.; Yeh, A.T.; Gland, J.L.; Moodenbaugh, A.R. Brookhaven National Lab., Upton, NY (United States). [1993]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-930405–12: Spring meeting of the Materials Research Society, San Francisco, CA (United States), 12-16 Apr 1993). Order Number DE93014325. Source: OSTI; NTIS; GPO Dep.

Direct comparisons between surface and bulk of diverse materials can be made by simultaneous electron yield (5 nm depth sensitivity) and fluorescence yield (200 nm) ultra soft x-ray absorption spectroscopy measurements utilizing a rapid sample interchange apparatus. For example the orientations of functional groups have been characterized at and near the surface of a series of model polymeric materials highlighting the chemical and molecular sensitivity of ultra soft x-ray absorption spectroscopy. In addition we discuss a bulk sensitive use of fluorescence yield to non destructively study a buried metal polymer interface. A second bulk sensitive example is the use of fluorescence yield oxygen K near edge x-ray spectroscopy as a method to determine the hole state density of high Tc materials.

26837 (CEAC-R–1-93) **Automatization of the neutron activation analysis method in the nuclear analysis laboratory.** Gonzalez, N.R. (Instituto Superior de Ciencia y Tecnologia Nuclear (ISCTN), La Habana (Cuba)); Rivero, D del C.; Gonzalez, M.A.; Larramendi, F. Instituto Superior de Ciencia y Tecnologia Nuclear (ISCTN), La Habana (Cuba); Centro de Estudios Aplicados al Desarrollo Nuclear (CEADEN), La Habana (Cuba). 1993. [7p.] (In Spanish), Order Number DE93630289. Source: OSTI; NTIS (US Sales Only); INIS.

In the present paper the work done to automatice the Neutron Activation Analysis technic with a neutron generator is described. An interface between an IBM compatible microcomputer and the equipment in use to make this kind of measurement was developed. including the specialized software for this system.

26838 (CONF-921101–125) **Application of Z-contrast imaging to obtain column-by-column spectroscopic analysis of materials.** Browning, N.D.; Pennycook, S.J. Oak Ridge National Lab., TN (United States). Jan 1993. 7p. Sponsored by USDOE, Washington, DC (United States); Oak Ridge Inst. for Science and Education, TN (United States). DOE Contract AC05-84OR21400. From 16. Material Research Society international symposium on the scientific basis for nuclear waste management fall meeting; Boston, MA (United States); 30 Nov - 5 dec 1992. Order Number DE93015333. Source: OSTI; NTIS; GPO Dep.

Z-contrast imaging has been shown to be an effective method for obtaining a high-resolution image from a scanning transmission electron microscope (STEM). The incoherent nature of the high-angle scattering makes image interpretation straightforward and intuitive with the resolution limited only by the 2.2 Å electron probe. The optimum experimental conditions for Z-contrast imaging also coincide with those used for analytical microscopy, enabling microanalysis to be performed with the same spatial resolution as the image. The detection limits afforded by a parallel detection system for electron energy loss spectroscopy (EELS) allows column-by-column core-loss spectroscopy to be performed using the Z-contrast image to position the electron probe. Preliminary results from the study of $YBa_2Cu_3O_{7-\delta}$ illustrate the spatial resolution available with this technique and the potential applications for materials science.

26839 (CONF-930945–1) **Synergism in the extraction of Cu(II) by polydentate thia ligands combined with didodecylnaphthalene sulfonic acid.** Moyer, B.A.; Sachleben, R.A.; Case, G.N. Oak Ridge National Lab., TN (United States). [1992]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From International solvent extraction conference (ISEC '93); York (United Kingdom); 9-15 Sep 1993. Order Number DE93001207. Source: OSTI; NTIS; GPO Dep.

Tetradentate alkyl thia ethers strongly enhance the extraction of Cu(II) from aqueous sulfuric acid solution by the strong-acid cation exchanger didodecylnaphthalene sulfonic acid (HDDNS). Among the 12-, 14-, and 16-membered macrocyclic tetradentate thia ethers, the strongest enhancement was found with the 14-membered ring. Weak enhancement was observed for one

monodentate and two bidentate alkyl thia ethers. Two acyclic tetradentate thia ethers exhibited stronger enhancement than expected from the aqueous-phase macrocyclic effect. An equilibrium scheme is proposed to rationalize the results for the tetradentate ligands. 14 refs, 5 figs.

26840 (CONF-930945–2) **Extraction of a alkali metal cations using a lipophilic lariat ether having a c-pivot carboxylic acid sidearm.** Sachleben, R.A.; Moyer, B.A.; Case, F.I.; Driver, J.L. Oak Ridge National Lab., TN (United States). [1992]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From International solvent extraction conference (ISEC '93); York (United Kingdom); 9-15 Sep 1993. Order Number DE93002830. Source: OSTI; NTIS; GPO Dep.

The extraction of alkali metal cations by the lipophilic, ionizable lariat ether bis-tert-octylbenzo- 14-crown-4-acetic acid (BOB14C4AA) dissolved in either o-xylene or 1-octanol was studied by two-phase potentiometric titration and ion-exchange chromatography. BOB14C4AA extracts alkali metal cations from aqueous chloride solutions predominantly by ion exchange in the range p[H] > 7. From an aqueous mixture of alkali metal halides, BOB14C4AA extracts Li^+ cation preferentially up to complete loading. When the alkali metals are extracted individually, however, BOB14C4AA extracts Li^+ cation with highest efficiency only up to ca. 45% loading. Both selectivity and efficiency for extraction of Li^+ cation are enhanced with 1-octanol diluent as compared to o-xylene diluent.

26841 (DOE/MC/25135–3341) **Gas separations using ceramic membranes: Final report, September 1988–February 1993.** Lin, C.L.; Wu, J.C.S.; Gallaher, G.R.; Smith, G.W.; Flowers, D.L.; Gerdes, T.E.; Liu, P.K.T. Aluminum Co. of America, Alcoa Center, PA (United States). Alcoa Technical Center. Feb 1993. 203p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC21-88MC25135. Order Number DE93000278. Source: OSTI; NTIS; GPO Dep.

This study covers a comprehensive evaluation of existing ceramic membranes for high temperature gas separations. Methodology has been established for microporous characterization stability and gas separation efficiency. A mathematical model was developed to predict gas separations with existing membranes. Silica and zeolitic modifications of existing membranes were pursued to enhance its separation efficiency. Some of which demonstrate unique separations properties. Use of the dense-silica membranes for hydrogen enrichment was identified as a promising candidate for future development. In addition, the decomposition of trace ammonia contaminant via a catalytic membrane reactor appears feasible. A further economic analysis is required to assess its commercial viability.

26842 (INIS-mf–12758, pp. 271-274) **Uranium determination in zirconium.** Serdeiro, N.H. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina). Dept. de Quimica); Bianco de Salas, G.H.; Correia, R.J. Asociacion Argentina de Tecnologia Nuclear, Buenos Aires (Argentina). 1987. [735p.] (In Spanish). (CONF-8711355–: 15. scientific meeting and 4th Latin American meeting and 1st sessions on nuclear power plants, San Carlos de Bariloche (Argentina), 2-6 Nov 1987). In *Proceedings of the fifteenth scientific meeting; fourth Latin American meeting; first sessions on nuclear power plants.* Order Number DE91003052. Source: OSTI; NTIS (US Sales Only); INIS.

The method used for the spectrometric uranium determination with 2-(2-thiolase)-5-diethylaminophenol was modified for its application in the zirconium samples analysis with an uranium content of the 0.1% order. The samples, previously dissolved in nitric acid, were submitted to a separative stage of liquid-liquid extraction, with a trioctylphosphine (TOPO) oxide diluted in cyclohexane. A sodium fluoride aqueous solution was necessary to be aggregated in the spectrometric determination so as to complex the zirconium vestiges, which could be present, originated by the Zr/U high relation of the initial sample. Under the established working conditions, different spectrometric assays, dyes absorption spectra and its uranium complex, complex stability, PH influence determination of the dyes-uranium relation, calculation of the complex's apparent formation constant and its molar absorption, were performed. (Author).

26843 (INIS-mf–12758, pp. 236-244) **High purity zirconium obtainment through the iodine compounds transport method.** Bolcich, J.C. (Comision Nacional de Energia Atomica, San Carlos de Bariloche (Argentina). Centro Atomico Bariloche); Zuzek, E.; Dutrus, S.M.; Corso, H.L. Asociacion Argentina de Tecnologia Nuclear, Buenos Aires (Argentina). 1987. [735p.] (In Spanish). (CONF-8711355–: 15. scientific meeting and 4th Latin American meeting and 1st sessions on nuclear power plants, San Carlos de Bariloche (Argentina), 2-6 Nov 1987). In *Proceedings of the fifteenth scientific meeting; fourth Latin American meeting; first sessions on nuclear power plants.* Order Number DE91003052. Source: OSTI; NTIS (US Sales Only); INIS.

This paper describes the experimental method and the equipment designed, constructed and actually applied for the high purity zirconium obtainment from a zirconium sponge of the nuclear type. The mechanism of purification is based on the impure metal attack with gaseous iodine (at 200 deg C) to obtain zirconium tetra iodine as main product which is then transformed into a pure zirconium base (at 1000-1300 deg C), precipitating the metallic zirconium and releasing the gaseous iodine. From the first experiences carried out, pure zirconium has been obtained from an initial filament of 0.5 mm of diameter as well as wires up to 2.5 mm of diameter. This work presents the results from the studies and analysis made to characterize the material obtained. Finally, the refining methods to which the zirconium produced may be submitted so as to optimize the final purity are discussed. (Author).

26844 (INIS-mf–12758, pp. 331-337) **Uranium removal from organic solutions of PUREX process.** Dell'Occhio, L.A. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina). Gerencia de Procesos Quimicos); Dupetit, G.A.; Pascale, A.A.; Vicens, H.E. Asociacion Argentina de Tecnologia Nuclear, Buenos Aires (Argentina). 1987. [735p.] (In Spanish). (CONF-8711355–: 15. scientific meeting and 4th Latin American meeting and 1st sessions on nuclear power plants, San Carlos de Bariloche (Argentina), 2-6 Nov 1987). In *Proceedings of the fifteenth scientific meeting; fourth Latin American meeting; first sessions on nuclear power plants.* Order Number DE91003052. Source: OSTI; NTIS (US Sales Only); INIS.

During the uranium extraction process with tributyl phosphate (TBP) in nitric medium, a bi solvated, non hydrated complex is formed, of formula UO2(NO3)2TBP, which is soluble in the diluent, a paraffin hydrocarbon. As it is known that some uranium salts, for instance the nitrate, when dissolved in organic solvents, like isopropanol, can be discharged as complex molecules at the cathode of an electrodeposition cell, it was decided to apply this technique to uranium loaded TBP solutions. From preliminary experiments resulted a practical possibility for the analytical control through the alpha measurement of electro deposits. This technique could be applied as well to the treatment of depleted organic streams carrying undesirable alpha activity, because the so treated solutions become deprived of uranium. This work presents the curves obtained working at constant voltage with uranium-loaded TBP solutions, the determination of the optimal operation voltage in these conditions, the electrodeposition yield for electro polished copper and stainless steel cathodes and the tests of reproducibility of deposits. A summary of the results obtained operating the high voltage supply at constant power is also presented. (Author).

26845 (INIS-mf–12758, pp. 345-352) **Solvents extraction: results obtained from cycle operation. Pt. 2.** Bonini, A.A. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina). Gerencia de Procesos Quimicos); Falcon, M.F.; Gauna, A.C.; Maymo, J.A. Asociacion Argentina de Tecnologia Nuclear, Buenos Aires (Argentina). 1987. [735p.] (In Spanish). (CONF-8711355–: 15. scientific meeting and 4th Latin American meeting and 1st sessions on nuclear power plants, San Carlos de Bariloche (Argentina), 2-6 Nov 1987). In *Proceedings of the fifteenth scientific meeting; fourth Latin American meeting; first sessions on nuclear power plants.* Order Number DE91003052. Source: OSTI; NTIS (US Sales Only); INIS.

In the first part of this work were described the results of the experimental program of one extraction cycle, scale 1:1, which represents that installed in the Laboratory of Radiochemical Processes

(LPR), using the system uranyl nitrate (natural uranium)-HNO3-H2O/TBP 30% in Molex. In the second part the following experiments were performed: (a) increase of uranium losses in the depleted solvent by introducing a high acidity current in the middle of the de-extraction contactor, in order to prevent the possible Pu(IV) polymerization; (b) increase of uranium losses in the depleted solvent when the de-extraction contactor is operated at room temperature instead of the design nominal value (60 deg C); (c) behaviour of cycle when it is operated with a higher solvent saturation than the design value; (d) determination of the limit decontamination factor of hardly extractable components, using Mg(NO3)2 as chemical tracer; (e) experimental evaluation of contamination of pulse generation systems and possible implications in the operation of LPR plant; (f) Transient related to the 'flushing' of uranium inventory that is contained in the cycle when the experimental program is finished. (Author).

26846 (JAERI-M–93-035) **Consecutive determination of pentavalent neptunium by spectrophotometric method.** Tanaka, Tadao (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment); Kamiyama, Hideo. Japan Atomic Energy Research Inst., Tokyo (Japan). Mar 1993. 27p. (In Japanese). Order Number DE93508314. Source: OSTI; NTIS; INIS.

Consecutive spectrophotometric determination of neptunium (V) was investigated on flow system, by using color reaction based on a complex formation with arsenazo III. Sample solutions containing $1 \times 10^{-6} \approx 1 \times 10^{-5}$ M neptunium (V) were used, and a 2×10^{-5} M arsenazo III (in HOAc-NaOAc buffer solution of pH 4.3) as a reagent solution. Two streams were propelled into flow-cell at the same flow rate of 0.5 ml/min by using a double plunger pump. Absorbance was measured at 650 nm. There was a linear relationship between $1 \times 10^{-6} \approx 1 \times 10^{-5}$ M neptunium (V), without influence of interfere ions dissolved out from various sedimental materials. The present method was successfully applied to the migration experiment of neptunium (V) in a sandy soil layer. (author).

26847 (JINR-D–14-91-395) **Recent development of radioanalytical method at IBR-2 pulsed fast reactor of the JINR.** Nazarov, V.M.; Pavlov, S.S.; Herrera, E. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Neutron Physics. 1991. [12p.] (In Russian). Order Number DE93628920. Source: OSTI; NTIS (US Sales Only); INIS.

Submitted to International Conference 'Modern Trends in Activation Analysis', Septemder, 16-20, 1991, Vienna, Austria.

The experience of the use of radioanalytical methods, including NAA at IBR-2 pilsed fast reactor of the JINR, is discussed. Physical and technical parameters of the experimental installation designed for NAA and radiography are given. The detailed examples of the application of resonance neutrons to the control of the environment in the geology of oil, in multi-element analysis of food products and superpure materials as well as in nuclear physics are reviewed. The works on the application of the neutron isotopes sources for express determination of nitrogen content in original and synthetic materials are introduced. 7 refs.; 8 figs.; 3 tabs.

26848 (LA–12522-C) **Proceedings of the Alfred O. Nier symposium on inorganic mass spectrometry.** Rokop, D.J. (comp.) (ed.). Los Alamos National Lab., NM (United States). May 1993. 268p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9105216–: Symposium on inorganic mass spectrometry, Durango, CO (United States), 7-9 May 1991). Order Number DE93014376. Source: OSTI; NTIS; INIS; GPO Dep.

Over 100 inorganic mass spectroscopists, including representatives from 9 different countries, attended. This proceedings contains 12 papers, 11 abstracts, and 38 poster abstracts; an author index is included.

26849 (LBL-PUB–719) **Current titles.** Lawrence Berkeley Lab., CA (United States). Apr 1993. 61p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. Order Number DE93015859. Source: OSTI; NTIS; INIS; GPO Dep.

116 abstracts are presented of work done with the electron microscope. NCEM is a DOE-designated national user facility and is available at no charge to qualified researchers (assess is controlled by a steering committee).

26850 (MHSMP–92-40) **Analysis of soil and water for TATB content.** Schaffer, C.L. Mason and Hanger-Silas Mason Co., Inc., Amarillo, TX (United States). Nov 1992. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-91AL65030. Order Number DE93009949. Source: OSTI; NTIS; GPO Dep.

A reverse-phase liquid chromatography (HPLC) method was developed for the analysis of TATB in soil samples. The soil samples were extracted with dimethylformamide (DMF). The extract was analyzed to determine the TATB content in the soil. The detection limit using this procedure was 2 parts/million (ppm) for TATB in the soil. An organic free sample of water was saturated with TATB. The water was filtered through a 0.2-μ filter, then injected into both a reverse-phase and normal-phase liquid chromatograph system. No peaks were detected. Therefore, the solubility of TATB in water is less than the detection limits of the chromatograph methods.

26851 (ORNL/FTR–4280) **Travel to Japan to participate in the international seminar on high-resolution STEM: Foreign trip report, June 9–16, 1992.** Pennycook, S.J. Oak Ridge National Lab., TN (United States). 1 Jul 1992. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93011067. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The traveler's visit to Sumitomo Metal Industries was shortly after the return of one of their research staff members, E. Takasuka, who had spent one year on a research assignment at ORNL in the traveler's group. Although a large steel-making company, Sumitomo Metals introduced a policy of diversification in 1988 and now spends 50% of its impressive research budget on advanced materials research of all kinds. The traveler visited the semiconductor research department. Most impressive was their level of investment in research equipment. Sumitomo Metals is not a leading supplier of semiconductor process equipment, but their Process Equipment Research Laboratory contained five electron cyclotron resonance (ECR) plasma systems for research on deposition and etching. A $\pm$4% uniformity in deposition is achieved with a single plasma source. Also, purely for research purposes are several molecular beam epitaxy deposition systems for growing GaAs on Si. There appear to be more systems than research staff, and all are located in a class 100 dean room. The Semiconductor Device Research Laboratory comprises a complete 0.8-μm large-scale integration process line, again entirely for research, into the development of specialized chips for graphics applications (a small "niche" market). This line also includes two ECR systems. Research spans from circuit design through metallization to long-term device characteristics monitoring. Almost every conceivable characterization tool is available-infrared tomographic imaging, Fourier transform infrared spectroscopy, a device that apparently can measure planarity across a wafer to su-nm accuracy, and all kinds of testing equipment for electrical characterization.

26852 (PNL-SA–21721) **A smart sensor system for trace organic vapor detection using a temperature-controlled array of surface acoustic wave vapor sensors, automated preconcentrator tubes, and pattern recognition.** Grate, J.W. (Pacific Northwest Lab., Richland, WA (United States)); Rose-Pehrsson, S.L.; Klusty, M.; Wohltjen, H. Pacific Northwest Lab., Richland, WA (United States). May 1993. 13p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-930571–18: 183. Electrochemical Society meeting, Honolulu, HI (United States), 16-21 May 1993). Order Number DE93015695. Source: OSTI; NTIS; GPO Dep.

A smart sensor system for the detection, of toxic organophosphorus and toxic organosulfur vapors at trace concentrations has been designed, fabricated, and tested against a wide variety of vapor challenges. The key features of the system are: An array of four surface acoustic wave (SAW) vapor sensors, temperature control of the vapor sensors, the use of pattern recognition to analyze the sensor data, and an automated sampling system including thermally-desorbed preconcentrator tubes (PCTs).

26853 (PNL-SA–22007) **Plutonium bioassay by inductively coupled plasma mass spectrometry ICP/MS.** Wyse, E.J.; Fisher, D.R. Pacific Northwest Lab., Richland, WA (United States). Apr 1993. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-9304128–12:

Department of Energy (DOE) radiation protection conference, Las Vegas, NV (United States), 13-15 Apr 1993). Order Number DE93015687. Source: OSTI; NTIS; INIS; GPO Dep.

The determination of plutonium in urine poses several analytical challenges, e.g., detectability, matrix, etc. We have investigated the feasibility of analyzing plutonium in processed urine by inductively coupled plasma mass spectrometry (ICP/MS). The urine samples are first spiked with ^{244}Pu as a tracer and internal standard, then processed by co-precipitation and column chromatography using TRU-Spec™, an extraction resin. By enhancing ICP/MS detection capabilities via improved sample introduction and data acquisition efficiencies, an instrumental detection limit of 5 to 50 fg (0.3 to 3 fCi for ^{239}pu) is typically obtained, depending on the desired degree of quantitation. A brief summary of the analytical method as well as the basis for measuring radionuclides by ICP/MS are submitted; the separation procedure, methods of sample introduction, and data acquisition techniques are then highlighted.

26854 (UCRL-ID–110984) **Raman scattering method for measuring HNO_3 concentration.** Wooldridge, J.; Johnson, G.W.; Cassidy, K.; Summers, L.; Lewis, P.; Gordon, S. Lawrence Livermore National Lab., CA (United States). Jun 1992. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93014833. Source: OSTI; NTIS; GPO Dep.

The Advanced Processing Technology (APT) group has been experimenting with several processes which are dependent upon nitric acid concentrations, thus a need exists to diagnose these quantities. This report describes a series of experiments which used the Raman scattering method for measuring nitric acid concentrations. These tests were performed at LLNL in Bldg. 241 during the months of September 1991 to December 1991. The basic instrument used for this series was a Spex Raman Spectrometer, Model 1488, with a DM1B computer system.

26855 (UCRL-JC–104107) **X-ray optics for scanning fluorescence microscopy and other applications.** Ryon, R.W. (Lawrence Livermore National Lab., CA (United States)); Warburton, W.K. Lawrence Livermore National Lab., CA (United States). May 1992. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-910862–9: Pacific-international congress on x-ray analytical methods, Honolulu, HI (United States), 12-16 Aug 1991). Order Number DE93015116. Source: OSTI; NTIS; INIS; GPO Dep.

Scanning x-ray fluorescence microscopy is analogous to scanning electron microscopy. Maps of chemical element distribution are produced by scanning with a very small x-ray beam. Goal is to perform such scanning microscopy with resolution in the range of <1 to 10 μm, using standard laboratory x-ray tubes. We are investigating mirror optics in the Kirkpatrick-Baez (K-B) configuration. K-B optics uses two curved mirrors mounted orthogonally along the optical axis. The first mirror provides vertical focus, the second mirror provides horizontal focus. We have used two types of mirrors: synthetic multilayers and crystals. Multilayer mirrors are used with lower energy radiation such as Cu Kα. At higher energies such as Ag Kα, silicon wafers are used in order to increase the incidence angles and thereby the photon collection efficiency. In order to increase the surface area of multilayers which reflects x-rays at the Bragg angle, we have designed mirrors with the spacing between layers graded along the optic axis in order to compensate for the changing angle of incidence. Likewise, to achieve a large reflecting surface with silicon, the wafers are placed on a specially designed lever arm which is bent into a log spiral by applying force at one end. In this way, the same diffracting angle is maintained over the entire surface of the wafer, providing a large solid angle for photon collection.

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Refer also to citation(s) 25478, 25479, 25545, 25744, 25824, 25910, 26050, 26534, 26786, 27522, 27661, 27721, 27879, 27888, 27902, 28059, 28147

26856 (BNL–48966) **The application of infrared synchrotron radiation to the study of interfacial vibrational modes.** Hirschmugl, C.J.; Williams, G.P. Brookhaven National Lab., Upton, NY (United States). [1992]. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-921277–1: NATO advanced research workshop, Maderia (Portugal), Dec 1992). Order Number DE93015393. Source: OSTI; NTIS; INIS; GPO Dep.

Synchrotron radiation provides an extremely bright broad-band source in the infrared which is ideally suited to the study of surface and interface vibrational modes in the range 50–3,000 cm^{-1}. Thus it covers the important range of molecule-substrate interactions, as well as overlapping with the more easily accessible near-ir region where molecular internal modes are found. Compared to standard broadband infrared sources such as globars, not only is it 1,000 times brighter, but its emittance matches the phase-space of the electrochemical cell leading to full utilization of this brightness advantage. In addition, the source is more stable even than water-cooled globars in vacuum for both short-term and long-term fluctuations. The authors summarize the properties of synchrotron radiation in the infrared, in particular pointing out the distinct differences between this and the x-ray region. They use experimental data in discussing important issues of signal to noise and address the unique problems and advantages of the synchrotron source. Thus they emphasize the important considerations necessary for developing new facilities. This analysis then leads to a discussion of phase-space matching to electrochemical cells, and to other surfaces in vacuum. Finally they show several examples of the application of infrared synchrotron radiation to surface vibrational spectroscopy. The examples are for metal crystal surfaces in ultra-high vacuum and include CO/Cu(100) and (111) and CO/K/Cu(100). The experiments show how the stability of the synchrotron source allows subtle changes in the background to be observed in addition to the discrete vibrational modes. These changes are due to electronic states induced by the adsorbate. In some cases the authors have seen interferences between these and the discrete vibrational modes, leading to a breakdown of the dipole selection rules, and the observation of additional modes.

26857 (CONF-930364–4) **Measurement of water diffusivity in aqueous lithium bromide solution.** Potnis, S.V.; Lenz, T.G.; Dunlop, E.H. Colorado State Univ., Fort Collins, CO (United States). Dept. of Agricultural and Chemical Engineering. [1993]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-86SF16306. From Spring national meeting of the American Institute of Chemical Engineers; Houston, TX (United States); 28 Mar - 1 apr 1993. Order Number DE93014705. Source: OSTI; NTIS; GPO Dep.

The bulb apparatus developed was found to produce reliable data for measuring diffusivity for short duration. Diffusivity of water in aq. LiBr solution was found to increase from 13.2×10^{-10} to $16.7\times10^{-10}m^2/s$ for concentration change from 0.5 to 4M and then decrease to a steady value of $\sim6.5\times10^{-10}m^2/s$ from 8 to 11 M.

26858 (DOE/ER/13183–8) **[Experimental and kinetic modeling of acid/base and redox reactions over oxide catalysts]: Technical progress report.** Wisconsin Univ., Madison, WI (United States). [1993]. 38p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-84ER13183. Order Number DE93016203. Source: OSTI; NTIS; GPO Dep.

The research has involved the characterization of catalyst acidity, ^{2}D NMR studies of Bronsted acid sites, and kinetic, calorimetric, and spectroscopic studies of methylamine synthesis and related reactions over acid catalysts. Approach of this work was to explore quantitative correlations between factors that control the generation, type, strength, and catalytic properties of acid sites on zeolite catalysts. Microcalorimetry, thermogravimetric analysis, IR spectroscopy, and NMR spectroscopy have provided information about the nature and strength of acid sites in zeolites. This was vital in understanding the catalytic cycles involved in methylamine synthesis and related reactions over zeolite catalysts.

26859 (DOE/ER/13933–3) **Quantum state resolved desorption of CO from solid surfaces: Final technical report.** Janda, K.C. Pittsburgh Univ., PA (United States). Dept. of Chemistry. [1992]. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-88ER13933. Order Number DE93016876. Source: OSTI; NTIS; GPO Dep.

The work consisted of two major efforts. First, we studied the recombinative desorption of hydrogen atoms from a Si(100) surface. The desorption kinetics turned out to scale with the first power of the hydrogen atom coverage on the surface instead of the second power. The interpretation of these results is rather controversial. The second series of studies focus on mixing of isotopic composition between CO molecules on a Ni(111) surface. The isotopic mixing reaction was found to proceed at modest surface temperatures, but not to go to completion even at high surface temperatures.

26860 (DOE/ER/14193–5) **Thermochemistry of transition metal clusters: Technical progress report.** Armentrout, P.B. Utah Univ., Salt Lake City, UT (United States). Dept. of Chemistry. [1993]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-91ER14193. Order Number DE93016201. Source: OSTI; NTIS; GPO Dep.

Objective is to obtain therodynamic properties of transition metal ion clusters, their binding energies to ligands, and their reactions, using a mass spectrometer and a photodissociation spectrometer. In addition to metal cluster ions, atomic metal ions with up to 4 H_2O molecules or He or Ar atoms as ligands have been generated.

26861 (DOE/ER/14273–1) **[Oxidation catalysis with tris(pyrazolyl)borate metal complexes]: Progress report.** Theopold, K.H. Delaware Univ., Newark, DE (United States). Dept. of Chemistry and Biochemistry. [1993]. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-92ER14273. Order Number DE93016214. Source: OSTI; NTIS; GPO Dep.

Progress was made in elucidating the mechanism of the O_2 activation by tris(pyrazolyl)borate cobalt complexes. A series of Tp^{i}Co-complexes (Tp^{i}=hydridotris(3-i-propyl-5- methylpyrazolyl)borate) was prepared.

26862 (DOE/PC/90035–T1) **Synthesis of 6-Methyl-9-propyldibenzothiophene-4-ol: Quarterly technical progress report No. 1, July 25, 1990– October 25, 1990.** Eisenbraun, E.J. Oklahoma State Univ., Stillwater, OK (United States). Dept. of Chemistry. 20 Nov 1990. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-90PC90035. Order Number DE93015780. Source: OSTI; NTIS; GPO Dep.

Conversion of 4'-methylpropiophenone to 1-methyl-4-n-propylbenzene was accomplished in high yields. Bromination of the latter resulted in isomers of methyl-n-propyl-1-bromobenzene. Reaction of the isomers with sodium butoxide and 2-methoxybenzenethiol in presence of $Pd[P(C_6H_5)_3]_4$ in 1-butanol was studied. The methylpropylbenzene was also iodinated. A decision to use iodination vs bromination will be made when more data are accumulated. 6 refs, figs.

26863 (DOE/PC/90035–T3) **Synthesis of 6-Methyl-9-n-propyldibenzothiophene-4-ol: Quarterly technical progress report No. 3, February 25, 1991–April 25, 1991.** Eisenbraun, E.J. Oklahoma State Univ., Stillwater, OK (United States). Dept. of Chemistry. 27 Apr 1991. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-90PC90035. Order Number DE93015778. Source: OSTI; NTIS; GPO Dep.

The material covered here can be divided into 3 parts: large-scale synthesis of 200+ grams of distilled 1,4-diethyl-2-[(2'-methoxyphenyl)thio]benzene, synthesis of sulfones both as starting materials for chemical cyclization reactions and as solid derivatives for identification purposes, and continued investigation of the cyclization to dibenzothiophenes both by chemical and photochemical means. 5 refs, figs.

26864 (DOE/PC/90035–T4) **Synthesis of 6-Methyl-9-n-propyldibenzothiophene-4-ol: Quarterly technical progress report No. 4, April 25–July 25, 1991.** Eisenbraun, E.J. Oklahoma State Univ., Stillwater, OK (United States). Dept. of Chemistry. 25 Jul 1991. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-90PC90035. Order Number DE93015777. Source: OSTI; NTIS; GPO Dep.

The material covered in this report is divided into two parts: further cyclization experiments on 1,4-diethyl-2-[(2'-methoxyphenyl)thio]benzene and its sulfone both by chemical and photochemical means, and progress toward synthesis of modified target molecule, 9-isopropyl-4-methoxy-6-methyldibenzo-thiophene. 8 refs, figs.

26865 (DOE/PC/90035–T5) **Synthesis of 6-Methyl-9-n-propyldibenzothiophene-4-ol: Quarterly technical progress report No. 5, July 28–October 28, 1991.** Oklahoma State Univ., Stillwater, OK (United States). 28 Oct 1991. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-90PC90035. Order Number DE93015776. Source: OSTI; NTIS; GPO Dep.

The material presented here has been described to some extent in Status Reports 12, 13, and 14 and covers the progress toward the synthesis of the modified target molecules 9-isopropyl-4-methoxy-6-methyldibenzothiophene (13) and 9-isopropyl-6-methyldibenzothiophene-4-ol (14). It is divided into three parts: (a) Dehydrogenation experiments On tetrahydrodibenzothiophene 12. (b) methoxyl methyl cleavage of 13 to 14 using boron tribromide. (c) isolation and purification of methoxydibenzothiophene 13.

26866 (INIS-mf–13538) **The extraction of titanium, chromium and cadmium from phosphoric acid solutions by para (1,1,3,3 tetramethyl butyl) phenyl phosphoric acid in kerosene diluent.** Mellah, Abdelhamid (Centre de Developpement des Materiaux, Algiers (Algeria)); Bauer, Denise. Secretariat d'Etat a la Recherche, Algiers (Algeria). Mar 1993. [9p.] Order Number DE93628963. Source: OSTI; NTIS (US Sales Only); INIS.

The distribution of titanium, chromium and cadmium between phosphoric acid solutions and solutions of para (1,1,3,3, tetramethyl butyl) phenyl phosphoric acid in kerosene diluent has been investigated under different conditions. The aqueous and organic phases were analyzed by inductively coupled emission atomic spectrophotometry. From the results it is found that the extraction efficiency of para (1,1,3,3 tetramethyl butyl) phenyl phosphoric acid for metals is Ti > Cr > Cd for [H3PO4] > 7 M and Cr > Cd > Ti mor [H3PO4]m< 5 M.

26867 (LA-UR–93-1527) **Destruction of waste energetic materials using base hydrolysis.** Benziger, T.M.; Buntain, G.A.; Sanchez, J.A.; Spontarelli, T. Los Alamos National Lab., NM (United States). [1993]. 10p. Sponsored by USDOE, Washington, DC (United States); Department of Defense, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-930572–3: 12. annual international symposium on thermal treatment technologies - incineration conference, Knoxville, TN (United States), 3-7 May 1993). Order Number DE93012738. Source: OSTI; NTIS; INIS; GPO Dep.

In dismantling weapons from stockpile reduction, environmentally acceptable degradation of the associated high explosive (HE) waste to non-energetic forms is a critical objective. Base hydrolysis appears to be a simple, inexpensive method for converting propellants, explosives, and pyrotechnics (PEPS) into non-energetic materials that can be released directly or, if necessary, treated further. We have demonstrated that many PEPs can be hydrolyzed with aqueous sodium hydroxide or ammonia at temperatures ranging from 60 to 150°C. Hydrolysis experiments have been performed on pure compounds as well as DOE and DoD formulations, such as plastic-bonded explosive (PBX) 9404, tritonal, and rocket motor propellant. Small particle size of the energetic material is desirable, but not necessary. We have decomposed molding powder, pressed charges up to two pounds in weight, and partially exposed, metal-encased pieces. The products formed are dependent on the starting material composition, but usually consist of organic and inorganic salts, e.g., sodium formate, acetate, nitrite and nitrate. The major gaseous product from the base hydrolysis of PEPs is nitrous oxide. The time required for complete destruction varies with the material being hydrolyzed, and is dependent on solubility and mass transfer. Hydrolysis rates can be increased by particle size reduction, efficient stirring, and addition of organic solvent to the alkaline solution. Rate enhancement by ultrasonic agitation is a possibility that we have just begun to study.

26868 (LBL–32461) **Conversion of ethane and of propane to higher olefin hydrocarbons: Quarterly report, April 1–June 30, 1992.** Heinemann, H.; Somorjai, G.A. Lawrence Berkeley Lab.,

CA (United States). Jun 1992. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. Order Number DE93015267. Source: OSTI; NTIS; GPO Dep.

Binary catalysts for oxydehydrogenation of ethane were prepared and tested: $Mo_{19}NbO_x$, Mo_4VO_x, V_5NbO_x. The combination of Mo and V is more active, selective than V-Nb or Mo and Nb. Nb in catalysts, particularly ternary, inhibits CO_2 formation. Propane oxydehydrogenation occurs at lower temperature than ethane conversion over both binary and ternary catalysts; however selectivity to propylene is lower than for ethylene from ethane. Propylene is completely converted to carbon oxides when charged to the catalyst in absence of propane. Attempts failed to obtain higher hydrocarbons by oligemerizing propylene over acidic catalysts as it is formed.

26869 (LBL–32845) **Pore-size-distribution of cationic polyacrylamide hydrogels: Progress report.** Kremer, M.; Prausnitz, J.M. Lawrence Berkeley Lab., CA (United States). Jun 1992. 80p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. Order Number DE93015218. Source: OSTI; NTIS; GPO Dep.

The pore size distribution of a AAm/MAPTAC (acrylamide copolymerized with (3-methacrylamidopropyl)trimethylammonium chloride) hydrogel was investigated using Kuga's mixed-solute-exclusion method, taking into account the wall effect. A Brownian-motion model is also used. Results show the feasibility of determining pore-size distribution of porous materials using the mixed-solute-exclusion method in conjunction with solution of the Fredholm equation; good agreement was obtained with experiment, even for bimodal pore structures. However, different pore size distributions were calculated for the two different probe-solutes (Dextran and poly(ethylene glycol/oxide)). Future work is outlined. 32 figs, 25 refs.

26870 (LBL–32956) **Swelling equilibria for temperature-sensitive ampholytic hydrogels.** Baker, J.P.; Stephens, D.R.; Blanch, H.W.; Prausnitz, J.M. Lawrence Berkeley Lab., CA (United States). Sep 1992. 27p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. Order Number DE93015264. Source: OSTI; NTIS; GPO Dep.

Temperature-sensitive N-isopropylacrylamide (NIPA)-based ampho-lytic hydrogels were synthesized by copolymerizing NIPA with the cationic monomer methacrylamidopropyl trimethylammonium chloride (MAPTAC) and the anionic monomer sodium styrene sulfonate (SSS). The total nominal charge density of the hydrogels was held constant at 8 mol % (dry basis), while the molar ratio of anionic to cationic moieties within the hydrogels was varied. Swelling equilibria were measured in water at 6C, and in aqueous sodium chloride solutions ranging in concentration from $10^{-5}$to 5 M and temperature ranging from 6 to 56C. Consistent with expectations, the swelling behavior of the hydrogels was found to be controlled by temperature at low salt concentrations; as the sodium chloride concentration increased, temperature control of hydrogel swelling decreased. Slight antipolyelectrolyte behavior was observed for the hydrogel prepared with equal molar amounts of MAPTAC and SSS.

26871 (LBL–33919-ABS) **Molecular beam studies of reaction dynamics.** Lee, Yuan T. Lawrence Berkeley Lab., CA (United States). Mar 1993. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-9306172–1: 15. combustion research contractors' meeting, Lake Harmony, PA (United States), 2-4 Jun 1993). Order Number DE93015035. Source: OSTI; NTIS: GPO Dep.

Thrust was to elucidate simple elementary reactions and to unravel mechanism of complex/photochemical reactions. Molecular beams are used to study reactions between molecules or to monitor photodissociation events in a collision-free environment. Recent activities centered on reactions involving oxygen atoms with unsaturated hydrocarbons, endothermic substitution reactions, dependence of reactivity of excited atoms on alignment of excited orbitals, photochemical reactions of polyatomic, energy transfer, free radicals in combustion processes, infrared absorption spectra of carbonium ions and hydrated hydronium ions, and bond-selective photodissociation.

26872 (NUTEK-FBT–93-9) **Studies of intermediates, in catalytic reactions, catalysts and catalytic combustion using laser and mass spectrometry.** Rosen, A. (Chalmers Univ. of Technology and Gothenburg Univ. (Sweden). Dept. of Physics). Swedish National Board for Industrial and Technical Development (NUTEK), Stockholm (Sweden). 1993. 20p. Project NUTEK-276-330. Order Number DE93500737. Source: OSTI; NTIS.

We have in this project focused our research on a study of the most simple model reaction, that includes OH-radicals, which is the oxidation of hydrogen to water on a metal catalyst. The OH radical is formed at the surface of the catalyst when molecular hydrogen and oxygen first dissociate at the surface and then recombine to OH, which are consumed in the water formation. The OH radical is very short-lived and the concentration is therefore low. If the catalyst is kept at a high temperature (> 1000 K) there is a small possibility that OH radicals desorb from the catalyst before being consumed in the water production. The OH radical has been detected and characterized with respect to its yield, activation energy for desorption and rotational energy using the laser-induced fluorescence technique (LIF). The project also includes space resolved studies of the OH radical outside the catalytic foil using imaging of the fluorescence light from the OH radicals with a diode array and CCD camera. In this study the desorption angle, rotational cooling of the reactants, possible gas phase reactions and different effects of the flow of the OH radicals are investigated. Further, impurities of the catalysts have been analyzed using the Laser Ionization Mass Spectrometry technique.

26873 (PNL–SA-22038) **The role of interfacial chemistry in surface nucleation and growth of calcium oxalate.** Song, L.; Campbell, A.A.; Bunker, B.C. Pacific Northwest Lab., Richland, WA (United States). [1993]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830 ;FG06-89ER75522. (CONF-930405–20: Spring meeting of the Materials Research Society, San Francisco, CA (United States), 12-16 Apr 1993). Order Number DE93015689. Source: OSTI; NTIS; GPO Dep.

The surface adsorption of Ca^{2+} and oxalate anions (Ox^{2-}) on SiO_2, TiO_2 and Al_2O_3 oxide colloids were by electrosonic amplitude measurements. Kinetics studies of CaO_x formation on the model oxide surfaces were carried out using constant composition method. Results suggested Ca^{2+} and Ox^{2-} adsorptiopn was promoted on the oxide surfaces with opposite charges, and the specific adsorption of the divalent ions also resulted in surface charge reversal. For heterogeous nucleation of CaO_x on the three model oxide surfaces, induction times ranged from 270 to 360 minutes compared with 1200 minutes estimated for homogeneous nucleation and 700 minutes for spontaneous or nucleation at pH 6.5 and S = 3.3. Lower nucleation barriers, 27 mJ/m^2 for SiO_2, 26 mJ/m^2 for TiO_2, were observed by studying the dependence of nucleation induction times as the function of solution supersaturation.

26874 (UCRL-JC–112346) **Electronic structure and enthalpy of hydrogen and helium mixtures.** Ross, M.; Klepeis, J.E.; Schafer, K.J.; Barbee, T.W. III. Lawrence Livermore National Lab., CA (United States). Nov 1992. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9208135–7: International conference on the physics of strongly coupled plasmas, Rochester, NY (United States), 17-21 Aug 1992). Order Number DE93014128. Source: OSTI; NTIS; INIS; GPO Dep.

The first local density approximation (LDA) calculations of the electronic structure, equation of state and enthalpy of mixing were carried out for a number of different compositions of hydrogen and helium in bcc and fcc lattices. These are fully quantum mechanical, self-consistent calculations utilizing state-of-the-art methods of electron band theory, which make no assumptions regarding pressure ionization. The major approximation in the LDA method is that the exchange and correlation energy is given by a free electron functional in terms of the local electron density. The majority of previous mixture calculations start with the assumption that both hydrogen and helium are pressure-ionized so that the electronic structure is approximately that of free or weakly screened electrons in the presence of positive ions. Stevenson used a hard-sphere mixture model for the ions with an ion-ion pseudopotential to

account for electron screening and predicted that a mixture containing 7% helium by number, the composition believed to be present in Jupiter and Saturn, would phase separate at a temperature of about 7000 K at 8 Mbar. Subsequent calculations carried out for the fully ionized mixture and for a mixture of screened ions (linear response theory) have all arrived at predictions similar to those of Stevenson. MacFarlane and Hubbard performed ThomasFermi-Dirac calculations for mixing enthalpies of hydrogen and helium in bcc and fcc lattices and predicted that phase separation would not occur at any temperature.

4004 Electrochemistry

Refer also to citation(s) 25722, 25834, 26573, 26767, 26912

4005 Photochemistry

Refer also to citation(s) 26793, 26795, 26871, 27373, 27882

26875 (ANL/CHM/CP–79508) **EXAFS studies on the structure of photoexcited cyclopentadienylnickelnitrosyl(C_5H_5NiNO).** Chen, L.X. (Argonne National Lab., IL (United States)); Bowman, M.K.; Montano, A.; Norris, J.R. Argonne National Lab., IL (United States). [1993]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-930405–3: Spring meeting of the Materials Research Society, San Francisco, CA (United States), 12-16 Apr 1993). Order Number DE93012880. Source: OSTI; NTIS; GPO Dep.

The structures of C_5H_5NiNO in a reversible photochemical reaction were studied via EXAFS, FTIR, and optical absorption spectroscopies. A photoexcited intermediate with distinctively different EXAFS, IR, and optical absorption spectra from those of the ground state molecules was generated upon irradiation using 365 mn light at 20K in a 3-methylpentane solution. The reverse reaction was induced by irradiation with 310 mn light. The EXAFS data analysis has shown a 0.12 Å elongation of the Ni-N bond and the bending, of Ni-N-0 in the photoexcited intermediate. Several ZINDO calculations were conducted based on the structures obtained from the EXAFS spectroscopy. These calculations reproduced the changes in the optical spectra and the intramolecular electron transfer in C_5H_5NiNO.

26876 (DOE/ER/14205–2) **Photochemical dynamics of surface oriented molecules: Progress report, August 1, 1992–July 31, 1993.** Ho, W. Cornell Univ., Ithaca, NY (United States). Dept. of Physics. [1993]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-91ER14205. Order Number DE93016289. Source: OSTI; NTIS; GPO Dep.

Photodesorption and photoreaction was investigated using a mass spectrometer, on O_2 alone and coadsorbed with CO on Pt(111) at 80 K. Desorption of O_2 continues for 1 ps, indicating multiple excitation of adsorbed O_2 by photogenerated hot electrons. The branching ratio for O_2 desorption to CO_2 product formation increases as the O_2 is photoexcited by femtosecond light pulses, in contrast to the larger CO_2 photoyield for nanosecond laser excitation.

26877 (LBL–34131) **Application of synchrotron radiation in chemical dynamics.** Heimann, P.; Koike, M.; Kung, A.H.; Ng, C.Y.; White, M.G.; Wodtke, A. Lawrence Berkeley Lab., CA (United States). May 1993. 31p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-9302107–Summ.: Application of synchrotron radiation and chemical dynamics workshop report, Oakland, CA (United States), 3-5 Feb 1993). Order Number DE93015040. Source: OSTI; NTIS; INIS; GPO Dep.

In October 1992, funding was approved to begin construction of a beamline and two end stations to support chemical dynamics experiments at LBL's Advanced Light Source (ALS). This workshop was organized to develop specifications and plans and to select a working team to design and supervise the construction project. Target date for starting the experiments is January 1995. Conclusions of the workshop and representative experiments proposed in earlier workshops to form the basis for beamline plans and end-station designs are summarized in this report. 6 figs.

4006 Radiation Chemistry

Refer also to citation(s) 25828, 27647

26878 (IAEA-TECDOC–696, pp. 189) **Status report on regulations for process control and trade in irradiated food and research in India.** Nair, P.M. (Bhabha Atomic Research Centre, Bombay (India)). World Health Organization, Manila (Philippines). Regional Office for the Western Pacific; Joint FAO/IAEA Div. of Nuclear Techniques in Food and Agriculture, Vienna (Austria). Mar 1993. (CONF-9201151–: WHO/IAEA/FAO seminar on harmonization of regulations on food irradiation in Asia and the Pacific, Kuala Lumpur (Malaysia), 20-24 Jan 1992). In *Harmonization of regulations on food irradiation in Asia and the Pacific: Proceedings of a seminar held in Kuala Lumpur, Malaysia, 20-24 January 1992.* [211p.] Order Number DE93629035. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. INDIA/food industry; MEAT/post-irradiation examination; MEAT/radiosterilization; CHEMICAL RADIATION EFFECTS; INDIA; MEAT; RADIOSTERILIZATION; RADICIDATION; RADURIZATION; REGULATIONS

26879 (INIS-mf–12758, pp. 57-62) **Hydrogen radiolytic production in light and heavy water mixtures under conditions similar to LOCA (loss of coolant accidents).** Garcia Rodenas, L. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina). Dept. de Quimica de Reactores); Ali, S.P.; Liberman, S.J. Asociacion Argentina de Tecnologia Nuclear, Buenos Aires (Argentina). 1987. [735p.] (In Spanish). (CONF-8711355–: 15. scientific meeting and 4th Latin American meeting and 1st sessions on nuclear power plants, San Carlos de Bariloche (Argentina), 2-6 Nov 1987). In *Proceedings of the fifteenth scientific meeting; fourth Latin American meeting; first sessions on nuclear power plants.* Order Number DE91003052. Source: OSTI; NTIS (US Sales Only); INIS.

H_2, HD and D_2 radiolytic yield in heavy and light water mixtures has been determined to supply the necessary data which will allow to make a realistic estimation of the solution of such gas under LOCA conditions as a function of time. (Author).

4007 Radiochemistry and Nuclear Chemistry

Refer also to citation(s) 25776, 25910

26880 (LA–12554) **Reduction of Pu(VI) with hydrogen peroxide: Effects of plutonium, perioxide, and iron concentrations and of reaction time.** Marsh, S.F.; Martinez, E.A.; Day, R.S.; Nixon, A.E. Los Alamos National Lab., NM (United States). Jun 1993. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93013598. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The rate and extent of PU(VI) reduction in 7 M nitric acid were measured as a function of the concentration of plutonium, the relative concentrations of hydrogen peroxide and iron, and the reaction time. Plutonium concentrations of 2, 5, 15, 30, and 50 g/L were evaluated. At each plutonium concentration, the tested mole ratios of H_2O_2/Pu were 0, 2, 4, and 8, and the mole ratios of Fe/Pu were 0, 0.1, 0.3, and 0.5. Plutonium oxidation states were determined by absorption spectrophotometry before treatment and after reaction periods of 30 min, 2 h, and 6 h. High concentrations of plutonium promote the reduction of PU(VI) by peroxide. Iron hinders the reduction of PU(VI) at low concentrations of plutonium but promotes the reaction at higher plutonium concentrations. Although a significant portion of PU(VI) is often reduced completely to PU(III) by peroxide in the absence of iron, PU(III) is reoxidized to PU(IV) in nitric acid when iron is present.

26881 Enantioselective synthesis of L-(-)-4-boronophenylalanine (L-BPA). Samsel, E.G. To Dept. of Energy. 1991. Filed date 4 Jun 1991. USA patent application 7-710,208. 26p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. Order Number DE93015704. Source: OSTI; NTIS; GPO Dep.

4-Boronophenylalanine (BPA) is being investigated for boron neutron capture therapy of metastatic melanomas and other tumors. It is believed that the pure enantiomer L-BPA is more biologically active than the D,L racemate. This patent discloses a

method of making substantially pure L-BPA. The method comprises the steps of reacting 4-bromobenzaldehyde with ethylene glycol, reacting the resulting acetal with Mg to produce a Grignard reagent and thereafter reacting with tributyl borate and then converting to an acid environment to form 4-boronobenzaldehyde, which is then reacted with diethanol amine, condensing the resulting ester with 2-phenyl-2-oxazolin-5-one to form an azlactone, reacting the azlactone with an alkali metal hydroxide, asymmetrically hydrogengating the product in the presence of Rh chelate to form L-(+)-N-benzoyl-4-boronophenylalanine, and thereafter acidifying this in an organic medium to produce L-BPA.

26882 (UCRL-ID–112994) **Measurement of plutonium and americium volatilities under thermal process conditions: Final report.** Krikorian, O.H.; Condit, R.H.; Fontes, A.S. Jr.; Fleming, D.L.; Magana, J.W.; Morris, W.F.; Adamson, M.G. Lawrence Livermore National Lab., CA (United States). 28 Apr 1993. 28p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93014365. Source: OSTI; NTIS; GPO Dep.

We have used the transpiration method to measure volatilities of Pu and Am from PuO_2(s) and PuO_2/2% AmO_2(s) in the presence of steam and oxygen at temperatures of 1230–1430 K. We find the volatile species to be $PuO_2(OH)_2$(g) and $AmO_2(OH)_2$(g) at vapor pressures on the order of 10^{-10} atm and 10^{-12} atm respectively under measurement conditions. For the Pu volatilization reaction, PuO_2(s) + 1/2 0_2(9) + H_20(g) = $PuO_2(OH)_2$(g), we obtain a free energy of reaction of ΔG^O_T = 231.3–0.0109 T in kj/mol, and for the Am volatilization reaction, AmO_2(s.s. in PuO_2) + 1/2 0_2(9) + H_20(g) = $AmO_2(OH)_2$(g), we obtain AG^O_T = 223.9–0.0109 T in kj/mol. We apply these results to the Rocky Flats Plant Fluidized Bed Incinerator to assess the amount of volatile Pu and Am produced in the secondary combustor chamber. Taking operating conditions of 550C combustor temperature, 40 kmols/h of total gas flow at 1 atm pressure, 0.1 atm 0_2(9), 0.05 atm H_20(g), PuO_2 (s) containing 200 ppm AmO_2 in the bed, and 6000 h of operating time per year, gives volatilization rates of 7 x 10^{-6}g Pu and 4 x 10^{-9}g Am/y.

26883 (WSRC-TR–92-438) **Materials compatibility of hydride storage materials with austenitic stainless steels.** Clark, E.A. Westinghouse Savannah River Co., Aiken, SC (United States). 21 Sep 1992. 26p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93013688. Source: OSTI; NTIS; GPO Dep.

This task evaluated the materials compatibility of $LaNi_{5-x}Al_x$ (x= 0.3, 0.75) hydrides and palladium coated kieselguhr with austenitic stainless steel in hydrogen and tritium process environments. Based on observations of retired prototype hydride storage beds and materials exposure testing samples designed for this study, no materials compatibility problem was indicated. Scanning electron microscopy observations of features on stainless steel surfaces after exposure to hydrides are also commonly found on as-received materials before hydriding. These features are caused by either normal heat treating and acid cleaning of stainless steel or reflect the final machining operation.

4008 Combustion, Pyrolysis, and High-Temperature Chemistry

Refer also to citation(s) 25762, 28146, 28147

26884 (BNL–48923) **Fifteenth combustion research conference.** Brookhaven National Lab., Upton, NY (United States). 1993. 391p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-9306172–: 15. combustion research contractors' meeting, Lake Harmony, PA (United States), 2-4 Jun 1993). Order Number DE93015758. Source: OSTI; NTIS; INIS; GPO Dep.

The BES research efforts cover chemical reaction theory, experimental dynamics and spectroscopy, thermodynamics of combustion intermediates, chemical kinetics, reaction mechanisms, combustion diagnostics, and fluid dynamics and chemically reacting flows. 98 papers and abstracts are included. Separate abstracts were prepared for the papers.

26885 (CONF-930392–2) **A proposed mechanism for the pyrolysis of diborane.** Colket, M.B.; Montgomery, J.A. Jr. United Technologies Research Center, East Hartford, CT (United States). [1993]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-86ER13560. Grant BES-ER-13560. From 1993 joint Central States and Eastern sections of the Combustion Institute; New Orleans, LA (United States); 15-17 Mar 1993. Order Number DE93014275. Source: OSTI; NTIS; GPO Dep.

We examined the technique used by Fridman and Fehlner. The products B_3H_7 and B_3H_9 were trace species observed over the mass range 34-38 amu. Additional reactions were included to form the tetraborane and pentaborane; the five-step reaction is tabulated along with rate and reverse rate constants. Predictions are compared to decomposition data of Clarke and Pease. 16 refs, 2 tabs, 2 figs.

26886 (DOE/ER/13934–T1) **Studies of combustion reactions at the state-resolved differential cross section level: Progress report, March 1, 1992–February 27, 1993.** Houston, P.L. Cornell Univ., Ithaca, NY (United States). Dept. of Chemistry. 12 Apr 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-88ER13934. Order Number DE93017605. Source: OSTI; NTIS; GPO Dep.

This program explores a new technique for obtaining differential cross sections with product state resolution. The three-dimensional velocity distribution of state-selected reaction products is determined by ionizing the appropriate product, waiting for a delay while it recoils along the trajectory imparted by the reaction, and finally projecting the spatial distribution of ions onto a two dimensional screen using a pulsed electric field. Knowing the arrival time allows the ion position to be converted to a velocity, and the density of velocity projections can be inverted mathematically to provide three-dimensional velocity distribution for the selected product. Apparatus has been constructed and tested using photodissociations. The proposed research will both develop the new technique and employ it to investigate methyl radical, formyl radical, and hydrogen atom reactions which are important in combustion processes. We intend specifically to characterize the reactions of CH_3 with H_2 and H_2CO; of HCO with 0_2; and of H with CH_4, CO_2 and O_2.

26887 (DOE/ER/14128–T1) **Reaction and diffusion in turbulent combustion: Progress report.** Pope, S.B. Cornell Univ., Ithaca, NY (United States). 18 Jun 1993. 37p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-90ER14128. Order Number DE93017085. Source: OSTI; NTIS; GPO Dep.

A class of turbulent combustion models known as PDF methods has been developed. These methods have the important virtue that both convection and reaction can be treated without turbulence-modelling assumptions. However, a mixing model is required to account for the effects of molecular diffusion. Currently, the available mixing models are known to have some significant defects. Motivation of the project is to seek a better understanding of molecular diffusion in turbulent reactive flows; and thereby to provide guidance to the development of improved mixing models. Principal approach taken in the research is to use Direct Numerical Simulations (DNS) to study the coupled processes of reaction and molecular mixing in turbulent combustion. Because of inevitable computational limitations, it is impossible to simulate turbulent combustion in the parameter range of practical interest. Instead, our approach is to study very simple turbulent reactive flows that contain qualitatively some of the same phenomena as real flames. Statistical models will be developed that are applicable to practical combustion devices. The DNS studies related to non-premixed combustion are described. An additional topic studied, was mixing from the viewpoint of relative molecular motion.

26888 (DOE/ER/14306–1) **Infrared spectroscopy of organic free radicals related to combustion processes.** Weisshaar, J.C. Wisconsin Univ., Madison, WI (United States). Dept. of Chemistry. 25 Feb 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-92ER14306. Order Number DE93017086. Source: OSTI; NTIS; GPO Dep.

We will explore a variant of resonant two-photon ionization (R2PI). Development of the IR + UV R2PI experiment is underway. We have used optical R2PI and pulsed field ionization detection to

obtain vibrational spectra of the benzyl and phenylsilane cations. In benzyl, we have learned about the vibronic coupling in the mixed 1^2A_2-2^2B_2 system near 450 nm by projecting the mixed states onto the manifold of cation vibrational states. In phenylsilane+, we find that the sixfold barrier to internal rotation of the silyl group is small (V_6= +19 cm^{-1}). We are beginning to understand the mechanisms of coupling of torsional states with vibrations, overall rotation, and other electronic states, and we are developing a model of internal rotation in aromatic compounds based on Weinhold's natural resonance theory. 1 tab, 14 refs.

26889 (LBL–33817) **A comparison of one and two dimensional flame quenching: Heat transfer results.** Ezekoye, O.A. (Texas Univ., Austin, TX (United States). Dept. of Mechanical Engineering); Greif, R. Lawrence Berkeley Lab., CA (United States). Mar 1993. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-930830–22: National conference and exposition on heat transfer, Atlanta, GA (United States), 8-11 Aug 1993). Order Number DE93015196. Source: OSTI; NTIS; GPO Dep.

A theoretical investigation of laminar premixed flame quenching is carried out. Two orientations in which a flame may contact a cold wall are compared and contrasted by solving the conservation equations of mass, energy, and species utilizing a finite difference methodology. A one-step mechanism is used to specify the reaction rates. A simple analytical model, which is in qualitative agreement with the numerical results, is also presented. The results show that the heat transfer histories for one and two dimensional laminar flame quenching are similar.

26890 (SAND–93-1069C) **Modeling ignition chemistry.** Hobbs, M.L.; Baer, M.R.; Gross, R.J. Sandia National Labs., Albuquerque, NM (United States). [1993]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9305189–3: 1993 joint Army, Navy, NASA, Air Force (JANNAF) Propulsion Systems Hazards Subcommittee meeting, Ft. Lewis, WA (United States), 10-14 May 1993). Order Number DE93012340. Source: OSTI; NTIS; GPO Dep.

An eXplosive CHEMical kinetics code, XCHEM was developed to solve the reactive diffusion equations associated with thermal ignition of energetic material. This method-of-lines code uses stiff numerical methods and adaptive meshing. Solution accuracy is maintained between multilayered materials consisting of blends of reactive components and/or inert materials. Phase change and variable properties are included in one-dimensional slab, cylindrical and spherical geometries. Temperature-dependent thermal properties was incorporated and modification of thermal conductivities to include decomposition effects are estimated using solid/gas volume fractions determined by species fractions. Gas transport properties are also included. Time varying temperature, heat flux, convective and thermal radiation boundary conditions, and layer to layer contact resistances are also implemented. The global kinetic mechanism developed at Lawrence Livermore National Laboratory (LLNL) by McGuire and Tarver used to fit One-Dimensional Time to eXplosion (ODTX) data for the conventional energetic materials (HMX, RDX, TNT, and TATB) are presented as sample calculations representative of multistep chemistry. Calculated and measured ignition times for explosive mixtures of Comp B (RDX/TNT), Octol, (HMX/TNT), PBX 9404 (HMX/NC), and RX-26-AF (HMX/TATB) are compared. Geometry and size effects are accurately modeled, and calculations are compared to experiments with time varying boundary conditions. Finally, XCHEM calculations of initiation of an AN/oil/water emulsion, resistively heated, are compared to measurements.

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Refer also to citation(s) 28080

26891 (SAND–93-0567C) **Vibration suppression by modulation of elastic modulus using shape memory alloy.** Segalman, D.J. (Sandia National Labs., Albuquerque, NM (United States)); Parker, G.G.; Inman, D.J. Sandia National Labs., Albuquerque, NM (United States). [1993]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9309116–1: Conference on vibration and noise, Albuquerque, NM (United States), 20-22 Sep 1993). Order Number DE93009834. Source: OSTI; NTIS; GPO Dep.

The first portion of this paper proposes a method of fabricating a material whose modulus can be changed substantially through the application of a specified stimulus. The particular implementation presented here indirectly exploits the large deformation associated with shape memory alloys to achieve the desired modulation of stiffness. The next portion of this paper discusses a class of vibration problems for which such materials have a serious potential for vibration suppression. These are problems, such as the spinning up of rotating machinery, in which the excitation at any time lies within a narrow frequency band, and that band moves through the frequency spectrum in a predictable manner. Finally, an example problem is examined and the utility of this approach is discussed.

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Refer also to citation(s) 25652, 25812, 25879, 26520, 26573, 26815, 26816, 27220, 27221, 27228, 27238, 27239, 27257, 27265, 27331, 27375, 27625, 27866, 27877, 28133, 28134, 28184

26892 (ANL/XFD/CP–78973) **Limit analysis of a spherical shell under ring load and the experimental verification.** Zhibi Wang (Argonne National Lab., IL (United States)); Kensun Den; Lingxi Qian. Argonne National Lab., IL (United States). [1993]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-930702–31: Pressure vessels and piping conference, Denver, CO (United States), 25-29 Jul 1993). Order Number DE93015545. Source: OSTI; NTIS; INIS; GPO Dep.

The upper bound limit theorem has been used here to study the limit load of spherical shell under ring load. A closed form solution for the limit load has been found. A series of experiments was performed with different sizes and different thicknesses of the spherical shell under different diameters of ring loads. Good agreement was found between the theory and the experimental results.

26893 (BNL–49036) **An assessment of the use of CARS for remote sensing.** Barletta, R.E. Brookhaven National Lab., Upton, NY (United States). Apr 1993. 22p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. Order Number DE93016736. Source: OSTI; NTIS; GPO Dep.

With the increased interest in controlling the manufacture of chemical weapons (CW) agents globally as well as the interest in controlling the development and spread of nuclear weapons has come a concomitant need for the development instrumentation which will allow for either remote or clandestine surveillance of potential production and transportation facilities. The ability to monitor the effluent of a suspected weapon's production plant from distances on the order of kilometers would provide the basis for treaty verification or for intelligence gathering. A number of potential techniques for accomplishing these ends are currently under development. In particular a technique based upon identification of the constituents of a mixture based upon the vibrational spectrum obtained using Raman spectroscopy is under development. Because this approach has range limitation due to the frequency of light being used for interrogation other methods which can accomplish the same ends even more remotely are of interest. To this end, a review of the appropriate literature has been conducted and the results of this review with respect to the application of coherent anti-Stokes Raman spectroscopy (CARS) to the remote detection of chemicals of interest has been conducted. This study is more limited in scope than a detailed developmental program which is currently being under taken by DESE Research, Inc. and is limited to the question as to whether CARS possesses adequate sensitivity to be used as a remote sensing technique. Since current interest in remote sensing centers around detection of CW production in conjunction with the recently signed international convention in this area, the detection of CW agents and simulants is given prominence in this discussion. The use of CARS for microscopic detection of such controlled materials, while not explicitly considered in this report, is a further application of the technology.

26894 (CBL–41) **Compact reinforced composite basic principles.** Bache, H.H. Aalborg Portland (Denmark). Cement- og Betonlaboratoriet. Apr 1987. 87p. Order Number DE93500157. Source: OSTI; NTIS.

Compact Reinforced Composite - CRC - is a new type of high-performance composite material which is based on strong, brittle matrix materials given a high degree of ductility. The material is particularly suitable for large elements and structures, enabling them to resist very large forced in tension, compression and shear. CRC is reinforced with densely arranged bars and a high concentration of fine fibres. The design strategy principles were to enable brittle matrix materials to strain harden by reinforcing them with a high concentration of fine, strong and stiff fibres - this increases the tensile stresses and tensile strains at which the matrix material cracks, to increase the ultimate tensile strains of the matrix materials when these deform together with the reinforcing bars by effective fixation to the bars, and to achieve a high degree of global and local ductility by means that ensure a small "brittleness number". Bending tests on CRC beams in which the binder consisted of densely packed Portland cement and microsilica in a steel-fibre-reinforced quartz-sand mortar and the main reinforcement was 8 mm diameter steel bars, demonstrated the unique behaviour of the new materials. The load capacity in bending was 5-10 times that of traditional, good reinforced concrete and almost the same as for structural steel, the formalized ultimate bending stress (normalized bending moment: $M/1/6\ bh^2$) being slightly more than 160 MPa. The matrix material remained uncracked under tensile loading right up to the yield limit of the reinforcing steel (tensile strains about 3 mm/m), whereas ordinary reinforced concrete cracks at tensile strains of only 3-5% of the yield limit of the reinforcing steel. (AB) (14 refs.).

26895 (CEA-R–5632) **Decommissioning of the vitrification cell of the Piver plant.** Jouan, A.; Deschaud, C.; Scelo, G. CEA Centre d'Etudes de la Vallee du Rhone, 30 - Marcoule (France). Dept. des Procedes de Retraitement. Feb 1993. [100p.] (In French). Order Number DE93631011. Source: OSTI; NTIS (US Sales Only); INIS.

This report may be considered as a testament following the decommissioning of the PIVER cell. After a brief historical review, it describes the organization and logistics set up to complete the dismantling work. The conditioning methods in packages, drums, shells or ANDRA waste containers are also described together with the problems that arose during the operation. The final decontamination status of the cell is then specified. The report also describes some Research and Development work conducted using more sophisticated decontamination processes. The cost of the project is discussed, together with a critical review of the overall PIVER decommissioning program.

26896 (DOE/CE/15495–T6) **A novel method for monitoring pipe wall thinning: Final report.** Hopenfeld, J. Hopenfeld (Joram), Rockville, MD (United States). Jun 1993. 22p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG01-90CE15495. Order Number DE93016265. Source: OSTI; NTIS; GPO Dep.

This report presents results from eight tasks which were formed to demonstrate commercial viability of a new technology for the early detection of corrosion damage. The tasks produced three products which are deployed to commercialize the technology: (1)Experimentally verified software package which allows instrument specification for wall thinning detection. (2) Eighteen months of field experience in the installation and monitoring of radioactive tracers for wall thinning. (3) Technology for environmental and process monitoring, which was not developed under this contract but evolved as a natural extension of the subject invention. Radioactive tracers are deployed to provide early seaming of corrosion attack on pipes and tanks. The results of this project clearly demonstrate that these monitors are ideal for harsh and difficult to access environments. It is believed that no other technology is capable of providing in situ wall thinning data in such environments. The early warning of wall thinning with radioactive tracers will be commercialized via licensing agreements. Power plants and refineries have the capabilities to deploy the technology which was developed and demonstrated under this project. Funds from licensing agreements will be invested in the establishment of a service to conduct the actual monitoring. This service will extend beyond corrosion monitoring to include environmental monitoring. Current environmental regulation and cleanup of polluted sites has created a market for low cost, in-situ, monitoring. Through its ownership of US Patents which offer the most economical means of monitoring vast areas for toxic compounds, the company is in a unique position to profit from the emerging new market. Negotiations are underway with companies with existing sales and distribubon outlets for the formation of joint ventures. Proposals for the ARPA initiative and the DOE/SBIR have been prepared in the area of environmental monitoring.

26897 (DOE/DP/00789–T279) **Test plan: Small scale seal performance tests: Test Series B.** Stormont, J.C. Sandia National Labs., Albuquerque, NM (United States). 18 Nov 1985. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93012210. Source: OSTI; NTIS; GPO Dep.

The purpose of this appendix to "Test Plan: Small Scale Seal Performance Tests (SSSPT)" is to provide details regarding the installation and testing of Test Series B. The original test plan provides the technical motivation and test design in general terms for Test Series A through E and the details of the installation and testing of Test Series A. As specified in the test plans operations plans for the remaining test series are to be prepared when the details become available. This is now the case for Test Series B. It is emphasized that the original test plan remains valid and is the general reference for the conduct of all of the test series of the SSSPT. Test Series B will evaluate the performance of horizontally emplaced concrete seals and as such will be a small scale evaluation of the concrete component of the planned panel seal. The objectives of Test Series B are: (1) To develop and evaluate a technique for the horizontal emplacement of a concrete seal; (2) To obtain data on the fluid flow performance of horizontally emplace concrete seal systems; (3) To obtain data on the structural performance of horizontally emplaced concrete seal systems; and (4) To provide data for the development and validation of predictive numerical codes and models.

26898 (EGG–10617-1216) **Survey of subsurface geophysical exploration technologies adaptable to an airborne platform.** Taylor, K.A. EG and G Energy Measurements, Inc., Las Vegas, NV (United States). Remote Sensing Lab. Dec 1992. 75p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC08-88NV10617. Order Number DE93015080. Source: OSTI; NTIS; INIS; GPO Dep.

This report has been prepared by the US Department of Energy (DOE) as part of a Research Development Demonstration Testing and Evaluation (RDDT&E) project by EG&G Energy Measurement's (EG&G/EM) Remote Sensing Laboratory. It examines geophysical detection techniques which may be used in Environmental Restoration/Waste Management (ER/WM) surveys to locate buried waste, waste containers, potential waste migratory paths, and aquifer depths. Because of the Remote Sensing Laboratory's unique survey capabilities, only those technologies which have been adapted or are capable of being adapted to an airborne platform were studied. This survey describes several of the available subsurface survey technologies and discusses the basic capabilities of each: the target detectability, required geologic conditions, and associated survey methods. Because the airborne capabilities of these survey techniques have not been fully developed, the chapters deal mostly with the ground-based capabilities of each of the technologies, with reference made to the airborne capabilities where applicable. The information about each survey technique came from various contractors whose companies employ these specific technologies. EG&G/EM cannot guarantee or verify the accuracy of the contractor information; however, the data given is an indication of the technologies that are available.

26899 (LA-UR–93-757) **MCNP/KENO criticality benchmarks.** McKinney, G.W. (Los Alamos National Lab., NM (United States)); Wagner, J.C.; Sisolak, J.E. Los Alamos National Lab., NM (United States). [1993]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930907–1: ANS topical meeting on physics and methods in criticality safety,

Nashville, TN (United States), 19-23 Sep 1993). Order Number DE93010711. Source: OSTI; NTIS; GPO Dep.

In the past, criticality safety analyses related to the handling and storage of fissile materials were obtained from critical experiments, nuclear safety guides, and handbooks. As a result of rising costs and time delays associated with critical experiments, most experimental facilities have been closed, triggering an increased reliance on computational methods. With this reliance comes the need and requirement for redundant validation by independent criticality codes. Currently, the KENO Monte Carlo transport code is the most widely used tool for criticality safety calculations. For other transport codes, such as MCNP, to be accepted by the criticality safety community as a redundant validation tool they must be able to reproduce experimental results at least as well as KENO. The Monte Carlo neutron, photon, and electron transport code MCNP, has an extensive list of attractive features, including continuous energy cross sections, generalized 3-D geometry, time dependent transport, criticality k_{eff} calculations, and comprehensive source and tally capabilities. It is widely used for nuclear criticality analysis, nuclear reactor shielding, oil well logging, and medical dosimetry calculations. This report specifically addresses criticality and benchmarks the KENO 25 problem test set. These sample problems constitute the KENO standard benchmark set and represent a relatively wide variety of criticality problems. The KENO Monte Carlo code was chosen because of its extensive benchmarking against analytical and experimental criticality results. Whereas the uncertainty in experimental parameters generally prohibits code validation to better than about 1% in k_{eff}, the value of k_{eff} for criticality is considered unacceptable if it deviates more than a few percent from measurements.

26900 (LA-UR–93-758) **New developments enhancing MCNP for criticality safety.** Hendricks, J.S.; McKinney, G.W.; Forster, R.A. Los Alamos National Lab., NM (United States). [1993]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9309120–1: American Nuclear Society meeting, Nashville, TN (United States), 19-23 Sep 1993). Order Number DE93010698. Source: OSTI; NTIS; INIS; GPO Dep.

Since the early 80's MCNP has had three estimates of k_{eff}: collision, absorption, and track length. MCNP has also had collision and absorption estimators of removal lifetime. These are calculated for every cycle and are averaged over the cycles as simple averages and covariance weighted averages. Correlation coefficients between estimators are also calculated. These criticality estimators are all in addition to the extensive summary information and tally edits used in shielding and other problems. A number of significant new developments have been made to enhance the MCNP Monte Carlo radiation transport code for criticality safety applications. These are available in the newly released MCNP4A version of the code.

26901 (LA-UR–93-1717) **Knowledge based systems: From process control to policy analysis.** Marinuzzi, J.G. Los Alamos National Lab., NM (United States). [1993]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9305187–2: Ideas in science and electronics, Albuquerque, NM (United States), 11 May 1993). Order Number DE93014582. Source: OSTI; NTIS; GPO Dep.

Los Alamos has been pursuing the use of Knowledge Based Systems for many years. These systems are currently being used to support projects that range across many production and operations areas. By investing time and money in people and equipment, Los Alamos has developed one of the strongest knowledge based systems capabilities within the DOE. Staff of Los Alamos' Mechanical & Electronic Engineering Division are using these knowledge systems to increase capability, productivity and competitiveness in areas of manufacturing quality control, robotics, process control, plant design and management decision support. This paper describes some of these projects and associated technical program approaches, accomplishments, benefits and future goals.

26902 (LA-UR–93-1822) **Anomalous effects of moderation in transportation and storage arrays - revisited.** Yearwood, D. (Los Alamos National Lab., NM (United States)); Clayton, E.D.; Koponen, B.L. Los Alamos National Lab., NM (United States). 10 Mar 1993. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9309120–3: American Nuclear Society meeting, Nashville, TN (United States), 19-23 Sep 1993). Order Number DE93014554. Source: OSTI; NTIS; INIS; GPO Dep.

A number of anomalies have been observed for fissile material arrays. This paper will review anomalous behavior associated with interstitial array moderation and correct one previously-misidentified anomaly. Most arrays show a maximum k_{eff} with low-density water moderation. An earlier study, however, did not show this maximum for unreflected $5\times5\times5$ and $10\times10\times10$ arrays of 15-kg ^{235}U spheres. Our present calculations with MCNP and KENO V.a, however, show low-density maximums for both unreflected and reflected arrays of these units. We conclude that the earlier calculations for unreflected arrays were in error – perhaps due to problem setup or code errors. The reactivity enhancement due to fissile material density reductions, however, still exits and is now seen to occur for both unreflected and water-reflected arrays.

26903 (ORNL/FTR–4270) **Travel to Grenoble, France, to attend and present two papers at the 1992 IEEE international conference on robotics and automation, and to visit three French robotics research laboratories (INRIA, LAAS, and LIFIA): Foreign trip report, May 8–24, 1992.** Pin, F.G. Oak Ridge National Lab., TN (United States). 11 Jun 1992. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93011065. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The traveler attended the IEEE International Conference on Robotics and Automation and presented two papers entitled "Design of an Omnidirectional and Holonomic Wheeled Platform Prototype" and "Autonomous Navigation of a Mobile Robot Using Custom-Designed Qualitative Reasoning VLSI Chips and Boards." The traveler also visited the robotics laboratories of the Institut National de Recherche en Informatique et Automatique (INRIA) in Sophia-Antipolis, the Laboratoire d'Automatique et d'Analyse des Systemes (IAAS) in Toulouse, and the Laboratoire d'Informatique Fondamentalle et d'Intelligence Artificielle (LIFIA) in Grenoble.

26904 (ORNL/FTR–4376) **Travel to attend a meeting in Austria to discuss issues related to criticality safety and overpacks in the transport of radioactive material: Foreign trip report, August 30–September 5, 1992.** Parks, C.V. Oak Ridge National Lab., TN (United States). 21 Sep 1992. 84p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93012354. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The traveler visited the International Atomic Energy Agency (IAEA) Headquarters to participate in a Consultants Service Meeting (CSM) concerning the provisions for criticality safety and overpacks in the Regulations for the Safe Transport of Radioactive Material. The CSM was organized by the IAEA to consist of nominees from the United States (the traveler), Germany (H. H. Schweer), and the United Kingdom (C. K. Wilson). The agenda for the CSM consisted primarily of identified problems and proposed amendments submitted by IAEA member states. A written report summarizing the discussion and recommendations on each issue was prepared by the consultants and will be submitted to a panel of criticality specialists that will convene at the second Revision Panel meeting for the Regulations to be held May 17–21, 1993.

26905 (RFP–4704) **PRA approach for determining criticality safety operational limits.** Lerum, H.F. II; Patlovany, R.W. EG and G Rocky Flats, Inc., Golden, CO (United States). [1993]. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC34-90DP62349. (CONF-9306143–9: Energy Facility Contractors Group safety analysis meeting, Denver, CO (United States), 16-18 Jun 1993). Order Number DE93015419. Source: OSTI; NTIS; INIS; GPO Dep.

Short communication. CRITICALITY/probabilistic estimation; CRITICALITY; SAFETY; LIMITING VALUES; SAFETY ANALYSIS; NUCLEAR ENGINEERING

26906 (SAND–92-2825C) **Three-dimensional shock wave physics simulations with MIMD PAGOSA on massively parallel computers.** Gardner, D.R. (Sandia National Labs., Albuquerque, NM (United States)); Vaughan, C.T.; Cline, D.D. Sandia National

Labs., Albuquerque, NM (United States). [1992]. 5p. Sponsored by USDOE, Washington, DC (United States); Department of Defense, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-930765–3: SCSC '93: summer computer simulation conference, Boston, MA (United States), 19-21 Jul 1993). Order Number DE93011682. Source: OSTI; NTIS; GPO Dep.

The numerical modeling of penetrator-armor interactions for design studies requires rapid, detailed, three-dimensional simulation of complex interactions of exotic materials at high speeds and high rates of strain. To perform such simulations, we have developed a multiple-instruction, multiple-data (MIMD) version of the PAGOSA hydrocode. The code includes a variety of models for material strength, fracture, and the detonation of high explosives. We present a typical armor/antiarmor penetration simulation conducted with this code, and measurements of its performance. The scaled speedups for MIMD PAGOSA on the 1024-processor nCUBE 2 parallel computer, measured as the simulation size is increased with the number of processors, reveal that small grind times (computational time per cell per cycle) and parallel scaled efficiencies of 90% can be achieved for realistic problems. This simulation demonstrates that massively parallel hydrocodes can provide rapid, highly-detailed armor/antiarmor simulations.

26907 (SAND–93-0304C, pp. 4, Paper 2) **Quantitative STM and AFM studies of the evolution of interface roughness.** Williams, R.S.; Tong, W.M. Sandia National Labs., Albuquerque, NM (United States). [1993]. (CONF-921101–108: 16. Material Research Society international symposium on the scientific basis for nuclear waste management fall meeting, Boston, MA (United States), 30 Nov - 5 dec 1992). In *Interface roughness: What is it and how is it measured?*. 35p. Order Number DE93009797. Source: OSTI; NTIS.

All modern theories of the kinetics of solid growth or etching using gas phase reactants predict that the surface will evolve into a rough morphology as the growth proceeds outward or the etching proceeds inward. This section presents a brief tutorial on how to obtain extremely accurate three-dimensional topographs of surfaces at various stages in the growth or etching process using STM (scanning tunneling microscopy) or AFM (atomic force miscoscopy) measurements. Methods of analyzing collected data are discussed. Also discussed are some of the strengths and weaknesses of the techniques and analysis.

26908 (SAND–93-1011) **Center of trace algorithms for extracting digitized waveforms from two-dimensional images.** Lee, J.W. Sandia National Labs., Albuquerque, NM (United States). May 1993. 27p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93015082. Source: OSTI; NTIS; GPO Dep.

A class of recording instruments records high-frequency signals as a two-dimensional image rather than converting the analog signal directly to digital output. This report explores the task of reducing the two-dimensional trace to a uniformly sampled waveform that best represents the signal characteristics. Many recorders provide algorithms for locating the center of trace. The author discusses these algorithms and alternative algorithms, comparing their effectiveness.

26909 (UCRL–52000-93-3) **Energy and Technology Review, March 1993.** Sefcik, J.A.; Quirk, W.J. (eds.). Lawrence Livermore National Lab., CA (United States). 1993. 39p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93013941. Source: OSTI; NTIS; GPO Dep.

The Lawrence Liver National Laboratory was established in 1952 to research on nuclear weapons and magnetic fusion energy. Since then, we have added other major programs, including fusion and laser isotope separation, biomedical and environmental science, strategic defense, and applied energy technology. These programs, in turn, require research in basic scientific disciplines, including chemistry and materials science, computer science and technology, engineering, and physics. This review is published monthly to report on unclassified work in all of our programs. This issue describes three endeavors. We have developed a multiple-frame, laser-illuminated, electro-optic camera system that produces sequential photographs of fast phenomena, such as the formation of shaped-charge jets, with unprecedented high resolution. Another project concerns a new rocket propulsion system for small spacecraft. This liquid rocket propulsion system won a 1992 R&D 100 award and features miniature pumps that can turn on and off and can change speed within a millisecond to meet a wide range of thrust requirements. The last project reported on pertains to computational integrated photonics: using numerical simulation to optimize photonic devices.

26910 (UCRL-CR–105013) **Final report for Allied-Signal Aerospace Company, Kansas City Division on protective glove permeation analysis.** Swearengen, P.M. (Lawrence Livermore National Lab., CA (United States)); Johnson, J.S.; Priante, S.J. Lawrence Livermore National Lab., CA (United States); Allied-Signal Aerospace Co., Kansas City, MO (United States). Kansas City Div. 22 Jun 1990. 66p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93009541. Source: OSTI; NTIS; INIS; GPO Dep.

We conducted 25 separate glove fabric permeation studies during this project. The permeations were carried out in the small (1 inch) glass ASTM cell. One other permeation study was carded out with a large (two inch) modified ASTM cell for comparison with the small cell results. We also compared the LLNL procedure from both large and small cells with the standard ASTM test procedure which uses a liquid solution on the breakthrough side of the fabric (the liquid is then sampled on a periodic basis). In all comparisons we observed a close-correlation in breakthrough times between the two procedures and the two cell sizes. In the course of this study, we tested ten different glove materials. These included neoprene (original ASTM round-robin sheet stock, 16 mil thickness), Edmont Sol-Vex (nitrile), Pioneer nitrile, Pioneer Pylox (polyvinyl chloride), North Viton (trademark for fluoroelastomers), North SilverShield (Norfoil, trademark for a flexible metallized laminate), Safety 4 4H (patented plastic laminate), and QRP PolyTuff (polyurethane) 20G-2000 (5 mil), 23G-2300 (1.5 mil), and 25G-2500 (1.5 mil). Three of the glove materials, Viton and Silver Shield (North), and 4H (Safety 4), did not allow any permeation measurable by our system to either 1,2-dichloroethane or 3% diphenylmercury (in 1,2-dichloroethane) for a period greater than six hours. A fourth material, QRP Poly Tuff 2OG-2000, did not allow any measurable penetration of Asilamine (an aromatic diamine) for a time pedod of greater than 4 hours. Breakthrough times and curves were obtained for all other tested materials. Eleven different chemicals were used to challenge the glove materials. These included acetone, Asilamine, 1,2-dichloroethane, dichloromethane, isopropyl alcohol, a mixture of 3% diphenylmercury in 1,2-dichloroethane (w/w), phenol, and Iso Verre Stripper, 4,4'-methylenedianil (MDA), 1,3-phenylenediamine (MPDA), and Shell Epon (R) curing agent Z.

26911 (UCRL-ID–107864) **Environmental hardening of equipment operating in an automated test bed enclosure: Special Isotope Separation Program (SIS).** Hayward, M.L. Lawrence Livermore National Lab., CA (United States). Dec 1990. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93014829. Source: OSTI; NTIS; GPO Dep.

Lawrence Livermore National Laboratory's Plutonium Systems Engineering plans to demonstrate a materials handling system in an automated test bed located in the cold test facility, in FY91. The equipment operating in the automated glove box test bed consists of a modified, bridge mounted robot that is electrically driven, robot tooling, a tilt-pour furnace, mechanisms for loading and unloading the furnace, mechanisms for loading and unloading the crucible, and mechanisms for button breakout and can opening. Each of the pieces of equipment mentioned have components such as motors (with or without brushes), bearings, resolvers, encoders, sliding surfaces, cabling, and electrical connectors that must function in the harsh environment of the test bed enclosure, and each of the components described must be hardened to the enclosure environment. The automated test bed is to provide a representation of a weapons-grade plutonium enclosure. Although the decision to operate the enclosure in a nitrogen or argon atmosphere has not been made, this report considers the dry argon atmosphere as the more difficult case. Other environmental requirements on the equipment operating in the test bed enclosure are: Low moisture

and low oxygen atmosphere, and some abrasive dust resulting from the process. A surrogate material will provide flow and dusting characteristics of weapons-grade plutonium oxide. Weapons-grade plutonium will not be introduced into the test bed enclosure. However, for future reference, radiation effects on materials are addressed.

26912 (UCRL-ID–114502) **Testing of CFC replacement fluids for arc-induced toxic by-products.** Cravey, W.R.; Goerz, D.A.; Hawley-Fedder, R.A. Lawrence Livermore National Lab., CA (United States). Jun 1993. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93017094. Source: OSTI; NTIS; GPO Dep.

The authors have developed a unique test-stand for quantifying the generation of perfluoroisobutylene (PFIB) in chlorofluorocarbon (CFC) replacement fluids when they are subjected to high electrical stress/breakdown environments. PFIB is an extremely toxic gas with a threshold limit value of 10 ppbv as set by the American Conference of Governmental Industrial Hygienists. They have tested several new fluids from various manufacturers for their potential to generate PFIB. Their goal is to determine breakdown characteristics and quantify toxic by-products of these replacement fluids to determine a safe, usable alternative for present CFC's.

26913 (UCRL-JC–108924) **Slidesurfaces with Adaptive New Definitions (SAND) for transient analysis.** Whirley, R.G.; Engelmann, B.E. Lawrence Livermore National Lab., CA (United States). 2 Jun 1992. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-921110–50: Winter annual meeting of the American Society of Mechanical Engineers (ASME), Anaheim, CA (United States), 8-13 Nov 1992). Order Number DE93014909. Source: OSTI; NTIS; GPO Dep.

This paper describes some recent developments in adaptive contact algorithms for the transient analysis of penetration and material failure. A failure criterion is defined for volumes of potentially failing material on each side of a contact surface. As material within an element fails, the element is removed from the calculation and the contact surface is adaptively redefined to include the newly exposed outer material boundary. This contact algorithm admits arbitrary combinations of shell and solid elements to facilitate the representation of composite or honeycomb structures. The algorithms and their application are illustrated with several large-scale simulations using the explicit transient analysis code DYNA3D.

26914 (UCRL-JC–110007) **Training end-users: An on-line help package.** Waite, M. Lawrence Livermore National Lab., CA (United States). Mar 1992. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9205138–4: North American Ingres Users Association (NAIUA) meeting, Tarpan Springs, FL (United States), May 1992). Order Number DE93015105. Source: OSTI; NTIS; GPO Dep.

No matter how wonderful your INGRES application, if the end users don't know how to use the application it will not be utilized. This paper discusses an on-line help package implemented in our manufacturing database application in order to help our user community use the application. The Materials Fabrication Division (MFD) of Mechanical Engineering is a series of machining shops that do production jobs for the Laboratory. The Fabrication Control System (FCS) is the user interface to an INGRES database. FCS tracks jobs as they traverse the machine shops and FCS maintains the employee payroll. This interface consists of VIFRED forms, menus and EQUEL Fortran code. The on-line help package is an interactive system that responds to the users "single key stroke" request for information. The information retrieved is based upon which help key is used and the form or menu from which the request is generated.

26915 (UCRL-JC–110265) **Measurements of experimental plasma brush behavior in hybrid armatures.** Hawke, R.S.; Morrison, J.J.; Susoeff, A.R. Lawrence Livermore National Lab., CA (United States). Apr 1992. 7p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9204102–10: 6. symposium on electromagnetic launch technology, Austin, TX (United States), 28-30 Apr 1992). Order Number DE93014993. Source: OSTI; NTIS; GPO Dep.

Hybrid Armatures used in railguns, consist of a conducting link which is commutated to the rails by plasma brushes. The formation, properties and stability of plasma brushes is important to the performance of the armature. This paper describes a set of experiments in which the effects of varying plasma brush parameters including the initial mass of metal foil used to form the plasma as well as the current were studied. The evolution of the plasma brush from a solid metal foil through its melt, vapor and plasma phase were observed. The resulting brush length and voltage drop were measured. The results of these tests will be presented, discussed and compared to numerical simulations.

26916 (WHC-SA–1719) **Nuclear Criticality Technology and Safety Project parameter study database.** Toffer, H. (Westinghouse Hanford Co., Richland, WA (United States)); Erickson, D.G.; Samuel, T.J.; Pearson, J.S. Westinghouse Hanford Co., Richland, WA (United States). Mar 1993. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (CONF-930907–3: ANS topical meeting on physics and methods in criticality safety, Nashville, TN (United States), 19-23 Sep 1993). Order Number DE93011284. Source: OSTI; NTIS; INIS; GPO Dep.

A computerized, knowledge-screened, comprehensive database of the nuclear criticality safety documentation has been assembled as part of the Nuclear Criticality Technology and Safety (NCTS) Project. The database is focused on nuclear criticality parameter studies. The database has been computerized using dBASE III Plus and can be used on a personal computer or a workstation. More than 1300 documents have been reviewed by nuclear criticality specialists over the last 5 years to produce over 800 database entries. Nuclear criticality specialists will be able to access the database and retrieve information about topical parameter studies, authors, and chronology. The database places the accumulated knowledge in the nuclear criticality area over the last 50 years at the fingertips of a criticality analyst.

26917 (WSRC-MS–93-167) **Design rules under development by ASME B and PV Subgroup on Containment Systems for Spent Fuels and High Level Waste Transport Packagings.** Eggers, A.G. Westinghouse Savannah River Co., Aiken, SC (United States). [1993]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-930702–17: Pressure vessels and piping conference, Denver, CO (United States), 25-29 Jul 1993). Order Number DE93011787. Source: OSTI; NTIS; INIS; GPO Dep.

The ASME Boiler and Pressure Vessel Code group designated as the Subgroup on Containment Systems for Spent Fuel and High Level Waste Packagings (SG-NUPACK) has developed a draft Code for containment components currently designated as Section III, Division 3 of the ASME Boiler and Pressure Vessel Code (Reference 1). There are four working groups under the main NUPACK subgroup that are responsible for various portions of the new Code. These are the Working Group on General Requirements, the Working Group on Material, the Working Group on Design and the Working Group on Fabrication and Examination. There are approximately 40 volunteers from industry (the US and Canada), universities, national laboratories and the NRC actively forging a consensus standard that will become the basis against which packaging containment will be evaluated. This paper provides a summary of the current draft design rules and a comparison of these rules with design criteria currently in use by the packaging community.

4204 Heat Transfer and Fluid Flow

Refer also to citation(s) 25589, 26230, 27402, 27906, 28146, 28147, 28157, 28158, 28164

26918 (ANL/MCT/CP–78185) **Implementation of an anisotropic turbulence model in the COMMIX- 1C/ATM computer code.** Bottoni, M.; Chang, F.C. Argonne National Lab., IL (United States). [1993]. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-930702–38: Pressure vessels and piping conference, Denver, CO (United States), 25-29 Jul 1993). Order Number DE93015541. Source: OSTI; NTIS; INIS; GPO Dep.

The computer code COMMIX-1C/ATM, which describes single-phase, three-dimensional transient thermofluiddynamic problems, has provided the framework for the extension of the standard k-ε turbulence model to a six-equation model with additional transport equations for the turbulence heat fluxes and the variance of temperature fluctuations. The new, model, which allows simulation of anisotropic turbulence in stratified shear flows, is referred to as the Anisotropic Turbulence Model (ATM) has been verified with numerical computations of stable and unstable stratified shear flow between parallel plates.

26919 (BNL–48897) **Two-phase flow instability and dryout in parallel channels in natural circulation.** Duffey, R.B. (Brookhaven National Lab., Upton, NY (United States)); Rohatgi, U.S.; Hughes, E.D. Brookhaven National Lab., Upton, NY (United States). [1993]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-930830–20: National conference and exposition on heat transfer, Atlanta, GA (United States), 8-11 Aug 1993). Order Number DE93014293. Source: OSTI; NTIS; GPO Dep.

The unique feature of parallel channel flows is that the pressure drop or driving head for the flow is maintained constant across any given channel by the flow in all the others, or by having a large downcomer or bypass in a natural circulation loop. This boundary condition is common in all heat exchangers, reactor cores and boilers, it is well known that the two-phase flow in parallel channels can exhibit both so-called static and dynamic instability. This leads to the question of the separability of the flow and pressure drop boundary conditions in the study of stability and dryout. For the areas of practical interest, the flow can be considered as incompressible. The dynamic instability is characterized by density (kinematic) or continuity waves, and the static instability by inertial (pressure drop) or manometric escalations. The static has been considered to be the zero-frequency or lowest mode of the dynamic case. We briefly review the status of the existing literature on both parallel channel static and dynamic instability, and the latest developments in theory and experiment. The difference between the two derivations lies in the retention of the time-dependent terms in the conservation equations. The effects and impact of design options are also discussed. Since dryout in parallel systems follows instability, it has been traditional to determine the dryout power for a parallel channel by testing a single channel with a given (inlet) flow boundary condition without particular regard for the pressure drop. Thus all modern dryout correlations are based on constant or fixed flow tests, a so-called hard inlet, and subchannel and multiple bundle effects are corrected for separately. We review the thinking that lead to this approach, and suggest that for all multiple channel and natural circulation systems close attention should be paid to the actual (untested) pressure drop conditions. A conceptual formulation is suggested as a basis for discussion.

26920 (CONF-9209344–1) **On the motion through a viscous fluid of a spherical particle touching a plane wall: Slip boundary conditions.** Davis, A.M.J.; Kezirian, M.T.; Brenner, H. Massachusetts Inst. of Tech., Cambridge, MA (United States). Dept. of Chemical Engineering. [1992]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-88ER13896. From 3. international symposium on current problems in rheology, biorheology and biomechanics; Moscow (Russian Federation); 1-5 Sep 1992. Order Number DE93012540. Source: OSTI; NTIS; GPO Dep.

Understanding the hydrodynamic forces acting upon immersed particles touching surfaces, is of central importance in clean room technology and a variety of rheological and biological applications. This paper addresses the translation and rotation of a sphere translating and rotating parallel to a nearby plane wall bounding an otherwise quiescent semi-infinite viscous fluid, allowing for slip on the wall and/or the sphere. The motivation for disregarding the classical, no-slip boundary condition on solid surfaces aries from an embarrassing discrepancy between theoretical and observed predictions of the translational velocity of a sphere 'rolling' under the influence of gravity down an inclined plane bounding an effectively semi-infinite viscous fluid. According to theory the force and torque on a translating and/or rotating sphere moving parallel to the plane wall become logarithmically infinite with the gap width as the gap between the sphere and well goes to zero. As such, the theoretical conclusion is that the sphere cannot translate down the plane, despite the gravity force that acts to animate it. Experiments, however, reveal that the sphere does, in fact, roll down the plane - at a reproducible mean terminal velocity. In the noninertial, small Reynolds number limit, the experimentally observed drag coefficient was found to be about 8.9 times that given by Stokes law for the unbounded case - thereby suggesting a conventional hydrodynamic wall effect, rather than the logarithmically singular behavior predicted by the theory. It was in an attempt to resolve this glaring contradiction that we have elected here to examine the possible effects of slip.

26921 (DOE/METC/C–93/7067) **Time-averaged hydrodynamic equations of fluidization.** O'Brien, T.J. (USDOE Morgantown Energy Technology Center, WV (United States)); Syamlal, M.; Nicoletti, P.; Celik, I. USDOE Morgantown Energy Technology Center, WV (United States). [1993]. 9p. Sponsored by USDOE, Washington, DC (United States). (CONF-930830–18: National conference and exposition on heat transfer, Atlanta, GA (United States), 8-11 Aug 1993). Order Number DE93013483. Source: OSTI; NTIS; GPO Dep.

A set of hydrodynamic equations proposed by Jackson described fluidized beds as interacting continua. Using either the theory of statistical mechanics or continuum mechanics, the granular material was represented as a continuum (or as many continua) which interacted with the interpenetrating fluidizing medium. The equations for each phase are formally similar to the familiar Navier-Stokes equations for a single fluid, except that there are interaction terms between the phases and the density of each phase is replaced by an effective density, the product of its intrinsic density and the volume fraction occupied by that phase. These equations have formed the basis of a hydrodynamic theory of fluidization. Since these equations are a coupled set of transient, multidimensional, partial differential equations, their solution requires extensive computational effort simplifying assumptions are made. The dimensionality of the equations is reduced to 1-D and/or the transient terms are dropped. In the former case, recirculation, which is an essential feature of the granular motion, can not be described. In the latter case, the fluctuating behavior. The purpose of this paper is to present time-steady hydrodynamic equations which still capture the effects of this essential aspect of fluidized-bed behavior. The obvious advantage is that the solution of time-steady equations is computationally more efficient than the calculation of a long time record, by solving the transient equations, and then calculating its time average. The disadvantage is that the effect of fluctuations must be accounted for by additional terms in the time-steady equations, which must be determined a priori. Time-steady equations, derived by merely dropping the transient term, neglect all (nonlinear) effects of bed fluctuations, which are a salient feature of the bed dynamics.

26922 (DOE/PETC/TR–93/2) **Flow of granular materials down an inclined plane.** Gudhe, R. (Pittsburgh Univ., PA (United States). Dept. of Mechanical Engineering); Rajagopal, K.R.; Massoudi, M.; Chi, R. USDOE Pittsburgh Energy Technology Center, PA (United States). May 1993. 31p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93013901. Source: OSTI; NTIS; GPO Dep.

The mechanics of flowing granular materials such as coal, sand, fossil-fuel energy recovery, metal ores, etc., and their flow characteristics have received considerable attention in recent years because it has relevance to several technological problems. In a number of instances these materials are also heated prior to processing, or cooled after processing. The governing equations for the flow of granular materials taking into account the heat transfer mechanism are derived using the continuum model proposed by Rajagopal and Massoudi (1990). For a fully developed flow of granular materials down an inclined plane, these equations reduce to a system of coupled ordinary differential equations. The resulting boundary value problem is solved numerically and the results are presented. For a special case, it is possible to obtain an analytic solution; this is given in the Appendix A of this report.

26923 (INIS-mf–12758, pp. 67-71) **Revision of nucleated boiling mechanisms.** Converti, J. (Comision Nacional de Energia

Atomica, San Carlos de Bariloche (Argentina). Centro Atomico Bariloche); Balino, J.L. Asociacion Argentina de Tecnologia Nuclear, Buenos Aires (Argentina). 1987. [735p.] (In Spanish). (CONF-8711355–: 15. scientific meeting and 4th Latin American meeting and 1st sessions on nuclear power plants, San Carlos de Bariloche (Argentina), 2-6 Nov 1987). In *Proceedings of the fifteenth scientific meeting; fourth Latin American meeting; first sessions on nuclear power plants.* Order Number DE91003052. Source: OSTI; NTIS (US Sales Only); INIS.

The boiling occurrence plays an important role in the power reactors energy transfer. But still, there is not a final theory on the boiling mechanisms. This paper presents a critical analysis of the most important nucleated boiling models that appear in literature. The conflicting points are identified and experiments are proposed to clear them up. Some of these experiments have been performed at the Thermohydraulics laboratory (Bariloche Atomic Center). (Author).

26924 (INIS-mf–12758, pp. 72-76) **Density waves instabilities in two phases flux parallel channels.** Guido Lavalle, G. (Comision Nacional de Energia Atomica, San Carlos de Bariloche (Argentina). Centro Atomico Bariloche); Converti, J.; Clausse, A. Asociacion Argentina de Tecnologia Nuclear, Buenos Aires (Argentina). 1987. [735p.] (In Spanish). (CONF-8711355–: 15. scientific meeting and 4th Latin American meeting and 1st sessions on nuclear power plants, San Carlos de Bariloche (Argentina), 2-6 Nov 1987). In *Proceedings of the fifteenth scientific meeting; fourth Latin American meeting; first sessions on nuclear power plants.* Order Number DE91003052. Source: OSTI; NTIS (US Sales Only); INIS.

An analysis to study the stability of a boiling parallel channels system is presented. The channels are represented by variables control volumes. An autovalues problem, whose solutions set up the flux stability, is obtained as result. An identical channels system response is analyzed. From this case, through the parameters perturbation theory, the stability condition and the asymmetric channels oscillation modes were found out. The importance of this original method is based on the possibility of obtaining analytic expressions which are very useful for systems design with two phase flux and which allow a better physical phenomenon interpretation. (Author).

26925 (INIS-mf–12758, pp. 77-83) **Study of the influence of sub-cooled boiling in natural convection.** Etchepareborda, A. (Comision Nacional de Energia Atomica, San Carlos de Bariloche (Argentina). Centro Atomico Bariloche); Clausse, A. Asociacion Argentina de Tecnologia Nuclear, Buenos Aires (Argentina). 1987. [735p.] (In Spanish). (CONF-8711355–: 15. scientific meeting and 4th Latin American meeting and 1st sessions on nuclear power plants, San Carlos de Bariloche (Argentina), 2-6 Nov 1987). In *Proceedings of the fifteenth scientific meeting; fourth Latin American meeting; first sessions on nuclear power plants.* Order Number DE91003052. Source: OSTI; NTIS (US Sales Only); INIS.

The circulation regime by natural convection is important as regards the abnormal conditions analysis or accidents in nuclear installations. In cases in which the heat flow is high, steam in subcooled liquid (subcooled boiling) may occur, thus affecting substantially the natural convection mechanism. This work presents a study of the subcooled boiling influence in a natural convection system. The effects of flows and temperatures, for various geometries, are analyzed. The possible effects of the dynamics of the system are also discussed. (Author).

26926 (INIS-mf–12758, pp. 84-88) **Influence of the inertia and gravity on the boiling flows stability.** Delmastro, D.F. (Comision Nacional de Energia Atomica, San Carlos de Bariloche (Argentina). Centro Atomico Bariloche); Clausse, A. Asociacion Argentina de Tecnologia Nuclear, Buenos Aires (Argentina). 1987. [735p.] (In Spanish). (CONF-8711355–: 15. scientific meeting and 4th Latin American meeting and 1st sessions on nuclear power plants, San Carlos de Bariloche (Argentina), 2-6 Nov 1987). In *Proceedings of the fifteenth scientific meeting; fourth Latin American meeting; first sessions on nuclear power plants.* Order Number DE91003052. Source: OSTI; NTIS (US Sales Only); INIS.

A study of boiling flows stability on the basis of a linear analysis is presented. From the homogeneous flows' conservation equations, a distributed parameters model, which allows to deal with the frequency field system, is obtained. The adimensional parameters which characterize the inertia effects and the gravity on the impulse equation, are identified. On the other hand, a mean volumes model which permits to gather analytic criteria helpful for the design and comprehension of the problem is developed. (Author).

26927 (JAERI-M–93-029) **Thermal property correlation package of hydrogen, carbon monoxide, carbon dioxide and methane.** Hada, Kazuhiko (Japan Atomic Energy Research Inst., Oarai, Ibaraki (Japan). Oarai Research Establishment). Japan Atomic Energy Research Inst., Tokyo (Japan). Mar 1993. 106p. (In Japanese). Order Number DE93508333. Source: OSTI; NTIS; INIS.

A thermophysical property correlation package of hydrogen, carbon monoxide, carbon dioxide and methane has been constructed from a critical evaluation of theoretical or empirical correlations available in the literature. The properties include density, isobaric specific heat, viscosity and thermal conductivity. Selected package correlations are summarized below: (1) For density, Peng-Robinson-Redlich-Kwong equation of state, (2) for specific heat, an expression from thermodynamic theory with the van der Waals equation of state and (3) for viscosity and thermal conductivity, generalized relationships by the use of dimensional analysis that were developed by G. Thodos group. From a comparative evaluation of the package correlations with measurements and selected values available, it has been concluded that except for specific heat these correlations are predictable with an acceptable accuracy. (author).

26928 (LUTMDN-TMVK–3157) **Mathematical models for heat exchangers.** Andersson, Sven. Lund Univ. (Sweden). Dept. of Heat and Power Engineering. Mar 1993. 135p. (In Swedish). Order Number DE93500693. Source: OSTI; NTIS.

This report gives a theoretical treatment of the dynamics and control of heat exchangers, with special emphasis on thermostatic regulation of district heating connected through-flow tap water heaters. With the aid of Laplace transformation analytical expressions for different kinds of transfer functions are calculated. Inverse transforms is calculated as infinite series, where Bessel functions are included. The solutions agree well with results from computer simulations of a discrete heat exchanger model. It is shown, that the greatest risk for instabilities arises at medium-fast temperature sensing. The report also present an investigation of a return-reducing valve, which is shown to be stable in all conditions. (9 refs., 28 figs., 4 tabs.).

26929 (UCRL-JC–109143) **Dynamical simulations of sedimentation.** Ladd, A.J.C. Lawrence Livermore National Lab., CA (United States). Dec 1991. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9110369–3: 3. Joint Department of Energy/National Science Foundation (DOE/NSF) workshop on flow of particulates and fluids, Worcester, MA (United States), 22-24 Oct 1991). Order Number DE93013838. Source: OSTI; NTIS; GPO Dep.

In previous work I have developed a numerical technique for computing the hydrodynamic interactions between suspended solid spheres [1-31]. By averaging appropriate elements of the mobility matrix over random (non-overlapping) configurations of hard spheres, the high-frequency or short-time hydrodynamic transport coefficients can be calculated; the results are in excellent agreement with experiment [3]. During sedimentation. microstructure rearrangements take place; thus the steady-state sedimentation velocity can differ from its initial value. Moreover the suspension does not sediment as a homogeneous unit; rather there is a substantial dispersion of the particle velocities due to microscopic inhomogeneities in panicle position. In this paper I present results arising from the dynamical simulation of sedimenting spheres; I limit myself to results at a single packing fraction, $\phi = 0.05$, to compare with the experimental results of Ham and Homsy [5]. The methodology is a straightforward development of that described in Refs. [1-3] for creeping flow hydrodynamic interactions. Given the location and the force (gravity) on each particle. the velocity and angular velocity are calculated. In this work it has been assumed that the force density on the surface of each sphere, arising from its interactions with the fluid, can be represented by a force, a torque and a stresslet.

26930 (UCRL-JC-111404) **A Baroclinic Model of turbulent dusty flows.** Kuhl, A.L. Lawrence Livermore National Lab., El Segundo, CA (United States). Apr 1992. 54p. Sponsored by USDOE, Washington, DC (United States); Department of Defense, Washington, DC (United States). DOE Contract W-7405-ENG-48. Contract DNA IACRO-92-824. (CONF-9204142–2: DNA numerical methods symposium, Menlo Park, CA (United States), 28 Apr 1992). Order Number DE93017122. Source: OSTI; NTIS; GPO Dep.

The problem considered here is the numerical simulation of the turbulent dusty flow induced by explosions over soil surfaces. Some of the unresolved issues are: (1) how much dust is scoured from such surfaces; (2) where does the dust go in the boundary layer; (3) what is the dusty boundary layer height versus time; (4) what are the dusty boundary layer profiles; (5) how much of the dust mass becomes entrained into the dust stem; and (6) where does the dust go in the buoyant cloud? The author proposes a Baroclinic Model for flows with large density variations that actually calculates the turbulent mixing and transport of dust on an adaptive grid. The model is based on the following idealizations: (1) a loose dust bed; (2) an instantaneous shock fluidization of the dust layer; (3) the dust and air are in local equilibrium (so air viscosity enforces the no-slip condition); (4) the dust-air mixture is treated as a continuum dense fluid with zero viscosity; and (5) the turbulent mixing is dominated by baroclinically-generated vorticity. These assumptions lead to an inviscid set of conservation laws for the mixture, which are solved by means of a high-order Godunov algorithm for gasdynamics. Adaptive Mesh Refinement (AMR) is used to capture the turbulent mixing processes on the grid. One of the unique characteristics of these flows is that mixing occurs because vorticity is produced by an inviscid, baroclinic mechanism. A number of examples are presented to illustrate these baroclinic effects including shock interactions with dense-gas layers and dust beds, and dusty wall jets of airblast precursors. The conclusion of these studies is that dusty boundary layers grow because of mass entrainment from the fluidized bed (and not because of viscous wall drag) as proven by the Mass Integral Equation.

4205 Materials Testing

Refer also to citation(s) 25841, 25912, 26067, 26125, 26598, 26847, 27229, 27235

26931 (SAND-92-2090C) **Simulation of orbital debris impacts on bumper shields.** Hertel, E.S. Jr. Sandia National Labs., Albuquerque, NM (United States). [1992]. 6p. Sponsored by USDOE, Washington, DC (United States); National Aeronautics and Space Administration, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9304135–2: 1. European conference on space debris, Darmstadt (Germany), 5-8 Apr 1993). Order Number DE93013773. Source: OSTI; NTIS; GPO Dep.

A series of numerical simulations have been performed using CTH to predict secondary debris formation and rear structure damage for typical bumper shields under a variety of impact geometries The simulations span a range of velocities from ~3 to 12 km/s and are compared to the experiment data for the lower velocities (3 to 7 km/s). For one velocity (~7 km/s), CTH was used to demonstrate the effects of bumper thickness on secondary debris formation and rear structure damage. CTH was also used to stimulate a 12 km/s impact of a sphere on a simple Whipple bumper shield and this result will be compared to analytic damage predictions at that velocity. It has been found that CTH accurately predicts secondary debris propagation and rear damage for velocities throughout the experimentally accessible range. The CTH damage predictions at 12 km/s result in a higher ballistic limit than would be predicted from the analytic techniques.

26932 (SAND-92-2460C) **Experimental technique to simulate orbital-debris impact on space shields at impact velocities over 10 km/s.** Chhabildas, L.C.; Boslough, M.B. Sandia National Labs., Albuquerque, NM (United States). [1992]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9304135–1: 1. European conference on space debris, Darmstadt (Germany), 5-8 Apr 1993). Order Number DE93011619. Source: OSTI; NTIS; GPO Dep.

With the development of a new HyperVelocity Launcher, HVL, at Sandia, it is now possible to perform experiments over the velocity range of 7 to 12 km/s. This velocity range has not been previously accessible for gram-size plates. This meets the requisite mass-velocity criteria established for the orbital debris environment. In this paper, the technique employed to launch thin flier plates to velocities not previously accessible on a two-stage light-gas gun is reported. In particular, this technique has been used on a two-stage light-gas gun to launch nominally 0.5 to 1.0-mm thick aluminum, titanium, and magnesium flier plates intact to velocities up to 12.2 km/s. Since the mass-velocity capability of the newly developed HVL meets the average specifications of the space debris environment, it is expected to be a useful tool to evaluate the effects of debris impact on space structures and debris shields. Examples of a plate impact i.e., orbital debris impact on a thin Whipple shield are presented in this paper.

26933 (SAND-92-2712C) **Isolation of a piezoresistive accelerometer used in high acceleration tests.** Bateman, V.I.; Brown, F.A.; Davie, N.T. Sandia National Labs., Albuquerque, NM (United States). [1992]. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9306170–1: 17. transducer workshop, San Diego, CA (United States), 22-24 Jun 1993). Order Number DE93013764. Source: OSTI; NTIS; GPO Dep.

Both uniaxial and triaxial shock isolation techniques for a piezoresistive accelerometer have been developed for pyroshock and impact tests. The uniaxial shock isolation technique has demonstrated acceptable characteristics for a temperature range of −50°F to +186°F and a frequency bandwidth of DC to 10 kHz. The triaxial shock isolation technique has demonstrated acceptable results for a temperature range of −50°F to 70°F and a frequency bandwidth of DC to 10 kHz. These temperature ranges, that are beyond the accelerometer manufacturer's operational limits of −30°F and +150°F, required the calibration of accelerometers at high shock levels and at the temperature extremes of −50°F and +160°F. The purposes of these calibrations were to insure that the accelerometers operated at the field test temperatures and to provide an accelerometer sensitivity at each test temperature. Since there is no NIST-traceable (National Institute of Standards and Technology traceable) calibration capability at shock levels of 5,000 g - 15,000 g for the temperature extremes of −50°F and +160°F, a method for calibrating and certifying the Hopkinson bar with a transfer standard was developed. Time domain and frequency domain results are given that characterize the Hopkinson bar. The NIST-traceable accuracy for the standard accelerometer in shock is ±5%. The Hopkinson bar has been certified by the Sandia Secondary Standards Division with an uncertainty of 6%.

4210 Combustion Systems

Refer also to citation(s) 26430, 26431, 26511, 27357

4220 Mining and Underground Engineering

Refer also to citation(s) 25607, 25757

4230 Marine Engineering

26934 (CBL-40) **Densified cement ultra-fine particle-based materials.** Bache, H.H. Aalborg Portland (Denmark). Cement- og Betonlaboratoriet. 1981. 35p. (CONF-8106349–1: 2. International conference on superplasticizers in concrete, Ottawa (Canada), 10-12 Jun 1981). Order Number DE93500154. Source: OSTI; NTIS.

This paper describes a new class of materials with binders of densely packed cement and ultra-fine particles arranged in the spaces between the cement. The new materials are shaped from a viscous mass in a low stress field - in spite of an extremely low water content (0.13 - 0.18 by weight of cement + ultra-fine particles). The dense packing is achieved by using a large quantity of superplasticizer. Concrete made with the new binder is far more durable than ordinary concrete and has a 3-5 times higher compressive strength than this (120-270 MPa). The geometric, kinematic and

dynamic principles for arranging the fine particles in a dense structure are discussed, with special reference to the role of dispersing agents. The chapters on the hardened materials and applications concentrate mainly on the principles for developing new composite materials and structures that combine the excellent properties of the new binder with properties which this does not posses, for example, high tensile strength and ductility. (au) (21 refs.).

4260 Components, Electron Devices and Circuits

Refer also to citation(s) 25896, 26059, 26088, 26556, 26769, 26794, 26826, 26827, 26998, 26999, 27073, 27079, 27200, 27217, 27525, 27882, 27884, 27885

26935 (ENEA-RT-INN–91-17) **Progress in excimer lasers.** Letardi, T.; Fu, S. ENEA, Frascati (Italy). Dipt. Sviluppo Tecnologie di Punta. Jun 1991. 31p. (CONF-9107262–1: 20. international conference on phenomena in ionized gases, Pisa (Italy), 8-12 Jul 1991; RT/INN–91-17). Order Number DE93799289. Source: OSTI; NTIS (US Sales Only); INIS.

The most attractive feature of excimer lasers is their capability to efficiently produce e.m. radiation in the UV region with high average or peak power, low divergence, narrow bandwidth and good spatial uniformity. These lasers are seen as good candidates as drivers in internal confinement fusion due to their good beam focussing capability and radiation absorption characteristics. A general look at developments which have occurred during the last decade in the commercialization of excimer lasers indicates an overall growing interest in these devices in the sectors of scientific research and industry. However, a more detailed examination of the most recent commercialization trend shows a decrease in applications. This paper examines the factors that may be causing this unexpected downturn in excimer laser applications and analyzes the current performance demands that are being placed on the high power density sources used in the lasers. Developments in excimer laser numerical codes and laser parameter measuring are also discussed. Two directions of development are suggested, i.e., F2 lasers and excimer fluorescent lamps, which appear to offer many interesting applications.

26936 (ETDE-IT–93-161) **ENEA compact millimetre wave FEL.** Doria, A.; Gallerano, G.P.; Giovenale, E.; Kimmitt, M.F.; Messina, G.; Renieri, A. ENEA, Frascati (Italy). Dipt. Sviluppo Tecnologie di Punta. 1993. 3p. (CONF-9309124–2: 18. annual international conference on infrared and millimeter waves, Colchester (United Kingdom), 6-10 Sep 1993). Order Number DE93799185. Source: OSTI; NTIS (US Sales Only).

This paper reports the performance characteristics of a compact Free Electron Laser (FEL) operating in the spectral range between 2 and 3.5 mm. A new scheme of laser pulse temporal-profile control is discussed together with the experimental results.

26937 (ETDE-IT–93-162) **Use of NAG routines for numerical simulation of free electron laser.** Dipace, A.; Sabia, E.; Vaccari, M. ENEA, Frascati (Italy). Dipt. Sviluppo Tecnologie di Punta; ENEA, Bologna (Italy). 1992. 7p. (CONF-9209367–1: NAGUA '92 users conference, Canterbury (United Kingdom), 9-11 Sep 1992). Order Number DE93799232. Source: OSTI; NTIS (US Sales Only); INIS.

The simulation of a FEL (free electron laser) amplifier relies on the coupled Maxwell equations and on the Lorentz force expression. A simplified simulation code can be obtained with a 1-D approximation, neglecting the dependence of laser field, undulator field and beam density on transverse variables. In this case,one simply obtains a set of 2n + 2 coupled Ordinary Differential Equations (ODE), n being the number of metaparticles considered (typically 64 to 256) for the dynamical evolution of FEL variables. The simulation in this case uses the D02CBF routine from NAG (Nottingham Algorithms Group) Fortran Library. The Adams method is very accurate and fast for each integration step. Moreover, the interpolation routine OUTC is very useful in saving further work because it allows dynamical variables to be computed while using a very long integration step. The implementation of the complete 3-D model is not an easy task. The main difference is that laser field equations become PDE's. This system of equations, plus boundary conditions, is transformed into a mixed algebraic-differential system by a Galerkin-type finite element method. Solution of the resulting set of algebraic and differential equations is obtained through the package D02NGF of the NAG Fortran Library well suited for MAD systems. To our knowledge, D02NGF is the best available routine for this purpose: efficient, easy to use and equipped with very clear diagnostics.

26938 (ETDE-IT–93-169) **Laser mirrors with variable reflected intensity and uniform phase shift.** Piegari, A.; Emiliani, G. ENEA, Casaccia (Italy). 1992. 3p. (CONF-9206138–3: 5. topical meeting on optical interference coating, Tucson, AZ (United States), 1-5 Jun 1992). Order Number DE93799190. Source: OSTI; NTIS (US Sales Only).

Mirrors with gaussian or super-gaussian reflected intensity profiles, used as output couplers of unstable laser resonators, give high-power diffraction-limited laser beams. Unfortunately, these devices often introduce a phase distortion of the transmitted wave front that can reduce the advantages of having a smooth intensity profile. Therefore, the phase profile should be controlled with proper design techniques. This paper illustrates this point by studying the optimum design of a coating for a high power carbon dioxide laser with a required intensity profile and a rather small radial phase variation. The paper explains why a multi-layer coating with only one variable layer is preferred, and suggests an alternative approach, consisting in the use of a mirror having a partial reflectance region in its center and an anti-reflection region in the surrounding area, to avoid the phase front distortion.

26939 (ETDE-IT–93-170) **Optimisation procedures using 'eye' merit function.** Piegari, A.; Emiliani, G. ENEA, Casaccia (Italy). 1992. 2p. (CONF-9206138–4: 5. topical meeting on optical interference coating, Tucson, AZ (United States), 1-5 Jun 1992). Order Number DE93799191. Source: OSTI; NTIS (US Sales Only).

An easy to use and versatile design tool, which reduces the risk of having undesired reflectance values at wavelengths not covered by conventional calculations, is suggested for the optimization of optical coatings. It consists of the use of a merit function combined with the simplex optimization method to simulate the action of the human eye evaluating how much a calculated optical coating performance curve approaches the desired curve. An illustrative example is given of the design of wide band antireflection coating for the infrared range.

26940 (ETDE-IT–93-180) **Numerical simulation of FEL amplifiers by NAG routines.** Dipace, A.; Sabia, E.; Vaccari, M. ENEA, Frascati (Italy). Dipt. Sviluppo Tecnologie di Punta; ENEA, Bologna (Italy). 1992. 7p. (CONF-9202182–1: NAG European technical seminar: Numerical and symbolic computations, Bologna (Italy), 18 Feb 1992). Order Number DE93799267. Source: OSTI; NTIS (US Sales Only); INIS.

The Free Electron Laser (FEL) is a device which converts the kinetic energy of a relativistic electron beam into coherent radiation. FEL interaction is represented by a coupled set of ordinary and partial differential equations describing laser field evolution. These numerical problems can be efficiently solved by NAG (Nottingham Algorithms Group) routines D02NGF and D02CBF, as shown in this communication.

26941 (ETDE-IT–93-190) **Saturation and cavity losses optimization in free electron lasers.** Dattoli, G.; Giannessi, L.; Torre, A. ENEA, Frascati (Italy). Dipt. Sviluppo Tecnologie di Punta. 1992. 12p. Order Number DE93799200. Source: OSTI; NTIS (US Sales Only).

This paper reconsiders the problem of optimum cavity losses for FEL (Free Electron Laser) operation. It uses the results of a recently proposed 1-dimensional saturation model and shows that, for large intra-cavity intensities, the FEL behaves as a conventional laser system.

26942 (KCP–613-5041) **Elimination of sodium cyanide and vapor degreasing from the passivation process.** Stimetz, C.J.; McKay, W.P. Allied-Signal Aerospace Co., Kansas City, MO (United States). Kansas City Div. Apr 1993. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00613. Order Number DE93013937. Source: OSTI; NTIS; GPO Dep.

This report is an examination of the vapor degreasing and alkaline descaling steps in the passivation process. Since parts that are to be passivated are fairly clean, the vapor degreasing step may be redundant. Sodium cyanide is a component of the alkaline descaling solution and would be desirable to eliminate because of environmental concerns. Evaluations were performed to determine if the vapor degreasing step could be eliminated and the cyanide removed from the descaling solution. The stainless steels used in these evaluations were 15-5 PH and 303 SE wrought materials and 17-4 PH casting material. Samples of these stainless steels were contaminated with five materials normally encountered prior to the passivation process. The contaminated samples were then passivated with the standard process and the modified process in which the vapor degreasing step was eliminated and the sodium cyanide removed from the descaling solution. After the passivation of these contaminated samples, Auger Electron Spectroscopy (AES) was used to measure the effectiveness of the standard and modified passivation processes.

26943 (KCP–613-5043) **Rigid-flexible printed wiring boards: Final report.** Sydow, E.V. Allied-Signal Aerospace Co., Kansas City, MO (United States). Kansas City Div. May 1993. 52p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00613. Order Number DE93013938. Source: OSTI; NTIS; GPO Dep.

Rigid-flexible printed wiring board materials, fabrication processes, product requirements, and reliability were established. Considerable effort was spent testing plated-through holes, analyzing plated-through hole failure mechanisms, and then incorporating materials, processes, and product requirements to provide adequate control and reduce failures. The principal processes developed were tooling concepts, process sequence, lamination, drilling, plasma etchback, copper electroplating, and solder coating. Product requirements and reliability were established with thermal shock, thermal stress, innerlayer adhesion, and fold flexibility tests. Plated-through hole failure mechanisms were analyzed with thermal mechanical and finite element analyses.

26944 (KCP–613-5078) **Miniature mechanism assembly: Final report.** Stubenhofer, R.L. Allied-Signal Aerospace Co., Kansas City, MO (United States). Kansas City Div. May 1993. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00613. Order Number DE93015595. Source: OSTI; NTIS; GPO Dep.

Miniature assembly operations were reviewed to provide candidates for improvements to part handling, assembly, fixturing, equipment setup, and work verification. Four areas of emphasis were chosen – two specific products and two generic processes. The work done in conjunction with this project resulted in improvements to flowtimes and yields. Groundwork for further improvements in miniature assembly operations is now in place.

26945 (LA-UR–93-1212) **Optical degradation issues for XUV projection lithography systems.** Newnam, B.E. Los Alamos National Lab., NM (United States). [1992]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-921047–3: Symposium on optical materials for high-power lasers, Boulder, CO (United States), 28-30 Oct 1992). Order Number DE93012658. Source: OSTI; NTIS; GPO Dep.

We review the degradation susceptibility of the various optical components proposed for use in XUV projection lithography systems at 13–20 nm. Contamination by laser plasma target debris and carbonaceous films are two primary hazards that must be essentially nullified. Pertinent experimental results of a number of researchers illustrate the present status.

26946 (LBL–33886) **Changes in electrical device characteristics during the formation of dislocations in situ in the TEM.** Ross, F.M. (Lawrence Berkeley Lab., CA (United States)); Hull, R.; Bahnck, D.; Bean, J.C.; Peticolas, L.J.; King, C.A.; Kola, R.R. Lawrence Berkeley Lab., CA (United States). Mar 1993. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-9304150–1: 8. conference on microscopy of semiconducting materials, Oxford (United Kingdom), 5-8 Apr 1993). Order Number DE93013910. Source: OSTI; NTIS; GPO Dep.

By adding electrical connections to a specimen heating holder for a transmission electron microscope, we have measured the characteristics of electronic devices such as diodes while they remain under observation in the microscope. We have made electron-transparent specimens from metastable GeSi/Si p-n junction diodes and introduced dislocations by heating in situ. The combination of electrical measurement and real-time observation of dislocation formation allows us to examine the electrical properties of dislocations in individual devices and the influence of defects on device performance.

26947 (SAND–92-2512C) **Thermal stress analyses of a header plate with a 51-PIN electrical feed-thru.** Bergmann, V.L.; McCollister, H.L. Sandia National Labs., Albuquerque, NM (United States). [1992]. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9309129–1: American Society of Mechanical Engineers (ASME) international electronics packaging conference, Binghampton, NY (United States), 29 Sep - 2 oct 1993). Order Number DE93011683. Source: OSTI; NTIS; GPO Dep.

An electronic package currently under development requires a hermetically-sealed electrical connection through a metal header plate. The electrical feedthru consists of 51 RA333 pins in an S-type glass ceramic insulator. Because the feedthru contains a large number of pins spaced closely together, a single glass preform rather than individual glass beads at each pin has been proposed. Finite element analyses were conducted to gain insight into the stress distribution in the header plate, glass, and pins. To verify the finite element analyses, a prototype part was manufactured and examined for cracking in the glass ceramic and for leakage of the glass-to-metal seal. Finite element analyses were then used to investigate effects of the plate geometry and yield strength on stresses in the assembly. This paper illustrates one way that finite element analyses can be used along with selective prototype manufacturing for a timely and cost-effective method of evaluating design parameters of electronic packages.

26948 (SAND–93-0910) **Evaluation of midband analog fiber optic telemetry links.** Hansen, G.J. Sandia National Labs., Albuquerque, NM (United States). May 1993. 46p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93015128. Source: OSTI; NTIS; GPO Dep.

Midband (1KHz – 500MHz) analog fiber optic data links were purchased for evaluation from three suppliers. Ortel Corp., Alhambra, CA, provided units built to the specifications. Kaman Sciences Corp, Colorado Springs, CO and Laser Diode Inc., Princeton, NJ, provided units similar to the specification but with significant differences. The final version of the Ortel units met the specification but were marginal in dynamic range. The other units failed to meet the specification but showed promise for future application.

26949 (SAND–93-1280C) **Development of uhf spark-switched L-C Oscillators.** Rinehart, L.F.; Aurand, J.F.; Lundstrom, J.M.; Frost, C.A.; Buttram, M.T.; Patterson, P.E.; Crowe, W.R. Sandia National Labs., Albuquerque, NM (United States). [1993]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-930616–2: 9. IEEE pulsed power conference, Albuquerque, NM (United States), 21-23 Jun 1993). Order Number DE93015019. Source: OSTI; NTIS; GPO Dep.

Spark switched L-C Oscillator (LCO) transmitters have operated in the Low, Medium, and High Frequency Bands (10's of kHz to 10's of MHz) throughout the history of radio. In the 1970's they were pushed into the vhf Band by Moran, et al. By applying ultra-fast gas switching techniques and by overcoming spark gap losses the authors have operated LCO transmitters in the uhf (300 MHz to 3 GHz) region. Repetition rates >1 kHz with peak voltages >100 kV have been achieved. Uhf oscillators are inherently small because of the low inductance and capacitance required to generate ultra-high frequencies. This size constraint forces the device to operate at very high voltage in order to store enough energy to drive the antenna in spite of series switch losses and parallel corona and stray capacity losses. The spark gap must close in a time short compared to one half an R-F cycle for efficient switching; this equates to a few hundred picoseconds at uhf. The LCO output is a damped sinusoid of a few cycles duration. While the fractional

bandwidth (3-dB bandwidth divided by the center frequency) can be 10% to 80% depending on the Q, it is much smaller than the bandwidth of UWB impulse sources (100% bandwidth with multioctave coverage). Compared to UWB, the narrower bandwidth permits the use of higher gain antennas which can efficiently increase the effective radiated power (ERP) over a given frequency range. The authors have constructed L-C Oscillators with center frequencies of 450 MHz up to 800 MHz. The Q of these oscillators varies from 6 to 8 for the 450 MHz device, down to 1 to 2 for the 800 MHz unit. Q is increased when a resonant antenna or antenna-reflector combination is added. Prototypes with simple fat-dipole antennas and small parabolic reflectors (8 inches x 20 inches) have radiated normalized electric field strengths of 30 kV/m at 1 meter (measured in far-field and extrapolated back to 1 meter).

26950 (UCRL-ID–113182) **Design and performance of the terawatt Cr:LISrAlF$_6$ laser system.** Ditmire, T.; Nguyen, H.; Herman, S.; Perry, M.D. Lawrence Livermore National Lab., CA (United States). 28 Jan 1993. 22p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93014678. Source: OSTI; NTIS; GPO Dep.

The authors have developed a compact, flashlamp-pumped Cr:LiSrAlF$_6$ laser system capable of producing peak powers in excess of one terawatt. The chirped pulse amplification approach has been optimized for amplification of femtosecond pulses in Cr:LiSrAlF$_6$. The system includes a Cr:LiSAF regenerative amplifier followed by a Cr:LiSAF power amplifier chain. The regenerative amplifier produces 12 mJ pulses at a 5 Hz repetition rate which are further amplified to energies above 300 mJ at a 0.5 Hz repetition rate. Recompression results in a pulse energy of 150 mJ and pulse duration of under 135 fsec.

26951 (UCRL-JC–109341) **Design, fabrication and testing of a miniature peristaltic membrane pump.** Folta, J.A.; Raley, N.F.; Hee, E.W. Lawrence Livermore National Lab., CA (United States). Apr 1992. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9206172–4: Solid state sensor and actuator workshop, Hilton Head Island, SC (United States), 21-25 Jun 1992). Order Number DE93013040. Source: OSTI; NTIS; GPO Dep.

A miniaturized peristaltic membrane pump has been designed, fabricated, and tested. Sequentially bulging three membranes into a flow channel will provide peristaltic pumping action. The deflection response of various membrane materials to applied pressure was measured to provide specifications for the flow channel which was designed and fabricated to closely match the shape of the bulging membranes. The pump has been designed to be driven with thermopneumatic actuators. Currently, an external pneumatic system is used to actuate the membranes to allow measurement and control of the actuation pressures required to demonstrate pumping action.

26952 (UCRL-JC–109388) **Recent results from material processing studies on new generation lasers.** Kautz, D.D.; Dragon, E.P.; Werve, M.E.; Hargrove, R.S. Lawrence Livermore National Lab., CA (United States). 9 Dec 1993. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-930658–1: 5. international conference on welding and melting by electron and laser beams, La Baule (France), 14-18 Jun 1993). Order Number DE93013841. Source: OSTI; NTIS; GPO Dep.

High power and radiance dye lasers developed at Lawrence Livermore National Laboratory show promise for material processing tasks. Evaluation using welding heat flow models suggests significant increases in precision and speed are expected. We started processing studies to determine the viability of these lasers for cutting and drilling. Titanium and stainless steel alloys were chosen as materials for the preliminary studies. Results show that cuts and holes with extremely fine features can be made with dye and copper-vapor lasers. High radiance beams produce low distortion and small heat affected zones. We have accomplished very high aspect ratios and micron scale kerfs and holes in both stainless steel and titanium alloys.

26953 (UCRL-JC–110706) **The Livermore X-ray Laser Program.** Matthews, D.L. Lawrence Livermore National Lab., CA (United States). 20 Aug 1992. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-920523–14: 3. international colloquium on x-ray lasers, Schliersee (Germany), 18-22 May 1992). Order Number DE93014118. Source: OSTI; NTIS; INIS; GPO Dep.

I will report on the status of x-ray laser development and its applications at Livermore. I will review some of our recent results and comment on where our future research is headed including plans for developing a compact x-ray laser users facility. Finally, I will briefly summarize the results of an X-ray Laser Applications Workshop that was held in San Francisco in January 1992.

26954 (UCRL-JC–111213) **Multi-frame x-ray imaging with a large area 40ps camera.** Bell, P.M. (Lawrence Livermore National Lab., CA (US)); Kilkenny, J.D.; Landen, O.L.; Hanks, R.L.; Wiedwald, J.D.; Bradley, D.K. Lawrence Livermore National Lab., CA (United States). 9 Nov 1992. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-920792–65: 37. annual Society of Photo-Optical Instrumentation Engineers (SPIE) international symposium on optical and optoelectronic applied science and engineering, San Diego, CA (United States), 19-24 Jul 1992). Order Number DE93017179. Source: OSTI; NTIS; GPO Dep.

The authors have developed a large area short pulse framing camera that is capable of sixteen frames and shutter times of 40ps per frame. This is accomplished with a high fidelity electrical circuit and a L/D = 20 microchannel plate, driven by a short pulse (80ps) high amplitude electrical driver. They show results of this work they have done to support this type of shutter time and the difficulties associated with large area high speed shuttering.

26955 (UCRL-JC–111851) **Optical and physical properties of the LiSrAlF$_6$:Cr laser crystal.** Smith, L.K.; Payne, S.A.; Tassano, J.B.; DeLoach, L.D.; Kway, W.L.; Krupke, W.F. Lawrence Livermore National Lab., CA (United States). 18 May 1993. 5p. Sponsored by USDOE, Washington, DC (United States); Department of Defense, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9302116–2: 8. Optical Society of America (OSA) meeting on advanced solid-state lasers, New Orleans, LA (United States), 1-3 Feb 1993). Order Number DE93014657. Source: OSTI; NTIS; GPO Dep.

We have measured several of the physical and optical parameters of the LiSrAlF$_6$:Cr or Cr:LiSAF laser material that are important to its laser performance, including the thermomechanical properties, water durabilities and Auger upconversion constants. A thermomechanical figure-of-merit has been determined from measurements of the fracture toughness, expansion coefficient, thermal conductivity, Young's modulus, and heat capacity. Tests of water durability suggest that a neutral pH of 7 is optimum to minimize water dissolution. The Auger effect was found to be a significant factor at higher Cr concentration, where excited-state migration leads to an increase in the upconversion rate. 17 refs, 1 fig, 4 tabs.

26956 (UCRL-JC–112163) **Repair of opaque defects on reflection masks for soft x-ray projection lithography.** Hawryluk, A.M. (Lawrence Livermore National Lab., CA (United States)); Stewart, D. Lawrence Livermore National Lab., CA (United States). Nov 1992. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-920575–1: Symposium on electron, ion and photon beams, Orlando, FL (United States), 26-29 May 1992). Order Number DE93015114. Source: OSTI; NTIS; GPO Dep.

We have developed a new technique for the repair of opaque defects on soft x-ray projection lithography reflection masks using ion beam etching. This technique clears the defect without damaging the multilayer mirror or introducing an absorptive element into the multilayer. Our procedure uses a thin, Si overcoat to protect the multilayers from the kinetic energy of the in beam, reduced ion beam energy, and a Ar or Si ion beam to avoid absorption losses.

26957 (UCRL-JC–112217) **Full-wave simulation of the thumbtack laser.** Hawkins, R.J.; Madsen, N.K.; Kallman, J.S.; Feit, M.D.; Shang, C.C.; Shore, B.W.; DeFord, J.F. Lawrence Livermore National Lab., CA (United States). Nov 1992. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract

W-7405-ENG-48. (CONF-930332–1: Optical Society of America integrated photonics research topical meeting, Palm Springs, CA (United States), 22-25 Mar 1993). Order Number DE93015110. Source: OSTI; NTIS; GPO Dep.

The whispering-gallery mode microdisk – or thumbtack – laser is a novel, strongly confining, microstructure with "potential for the integrability and low-power operation required for large-scale photonic integration". It is a thin dielectric ($n \approx 3.5$) cylinder – or disk – on top of a rhomboid post. Analysis of the optical modes of this structure have, to date, consisted of scaling arguments drawn from the theory of whispering-gallery spheres. While this analysis has proved useful in understanding the basic aspects of the operation of this laser, it is limited. The authors have undertaken a complete electromagnetic analysis of the thumbtack laser using 2-D, 2.5-D and 3-D Finite-Difference Time-Domain (FDTD) codes which range in complexity from 2-D studies of the mode structure of the disk to a geometrically complete 3-D analysis of the radiation emitted from the laser. The goal of this project is to predict changes in the optical behavior that accompany structural changes in and about the laser described elsewhere in these proceedings, and to guide optimized device design.

26958 (UCRL-JC–113290) **Experimental measurements of selenium x-ray laser spectral line profiles.** Koch, J.A. (Lawrence Livermore National Lab., CA (US)); MacGowan, B.J.; Da Silva, L.B.; Matthews, D.L.; London, R.A.; Lee, R.W.; Mrowka, S.; Underwood, J.H.; Batson, P.J. Lawrence Livermore National Lab., CA (United States); Lawrence Berkeley Lab., CA (United States). 1 Mar 1993. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48 ;AC03-76SF00098. (CONF-921256–5: 1992 international conference on lasers, Houston, TX (United States), 7-11 Dec 1992). Order Number DE93016543. Source: OSTI; NTIS; GPO Dep.

The authors discuss their recent measurements of the spectral width of the 206.38 Å x-ray laser transition in Ne-like Se. These measurements used a high-resolution grating spectrometer and were performed over a wide range of laser amplifier lengths. The data have enabled them to extrapolate the intrinsic line width and to observe the effects of gain-narrowing and saturation on the line profile. They find an intrinsic width which is 1.4 times the Doppler width, they observe gain-narrowing in intermediate length amplifiers, and they observe no re-broadening in long, saturated amplifiers. These results suggest that collisional line-broadening has a significant effect on the line profile and saturation behavior of this laser.

26959 (UCRL-JC–113407) **Laser and spectroscopic properties of Yb-doped apatite crystals.** DeLoach, L.D. (Lawrence Livermore National Lab., CA (United States)); Payne, S.A.; Krupke, W.F.; Smith, L.K.; Kway, W.L.; Tassano, J.B.; Chai, B.H.T. Lawrence Livermore National Lab., CA (United States). 18 May 1993. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9302116–1: 8. Optical Society of America (OSA) meeting on advanced solid-state lasers, New Orleans, LA (United States), 1-3 Feb 1993). Order Number DE93014656. Source: OSTI; NTIS; INIS; GPO Dep.

Favorable spectroscopic and laser properties were measured in several Yb-doped apatite crystals: $Ca_5(PO_4)_3F$, $Sr_5(PO_4)_3F$, and $Ca_{5-x}Sr_x(PO_4)_3F$ (x=1-3). The properties included absorption and emission spectra, and laser pumping (slope efficiency).

43 PARTICLE ACCELERATORS

Refer also to citation(s) 27608, 28084, 28085

26960 (IFVE-OMVT–92-39) **The possibility of expert system application to accelerator control.** Afonin, A.G.; Volkov, B.S.; Ukhov, V.I. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov (Russian Federation). Inst. Fiziki Vysokikh Ehnergij. 1992. [16p.] (In Russian). Order Number DE93628247. Source: OSTI; NTIS (US Sales Only); INIS.

This report gives the introduction to expert system and its utilization in high energy physics. Some examples of expert system applications to the accelerator control are considered. Approach to expert system development for U-70 extraction system is suggested. 11 refs.; 3 figs.

26961 (LA-UR–93-1704) **Rigid-beam model of a high-efficiency magnicon.** Rees, D.E. (Los Alamos National Lab., NM (United States)); Tallerico, P.J.; Humphries, S.J. Jr. Los Alamos National Lab., NM (United States). [1993]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930511–87: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014431. Source: OSTI; NTIS; INIS; GPO Dep.

The magnicon is a new type of high-efficiency deflection-modulated amplifier developed at the Institute of Nuclear Physics in Novosibirsk, Russia. The prototype pulsed magnicon achieved an output power of 2.4 MW and an efficiency of 73% at 915 MHz. This paper presents the results of a rigid-beam model for a 700-MHz, 2.5-MW 82%-efficient magnicon. The rigid-beam model allows for characterization of the beam dynamics by tracking only a single electron. The magnicon design presented consists of a drive cavity; passive cavities; a pi-mode, coupled-deflection cavity; and an output cavity. It represents an optimized design. The model is fully self-consistent, and this paper presents the details of the model and calculated performance of a 2.5-MW magnicon.

4301 Design, Development, and Operation

Refer also to citation(s) 25916, 25917, 27052, 27137, 27262, 27527, 27848, 28063, 28069

26962 (ANL/EP/CP–79507) **The Continuous Wave Deuterium Demonstrator (CWDD) design and status.** Todd, A.M.M. (Grumman Space and Electronics Corp., Princeton, NJ (United States)); Nightingale, M.P.S.; Yule, T.J. Argonne National Lab., IL (United States). [1992]. 4p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract W-31109-ENG-38. Contract DASG60-88-C-0060. (CONF-930511–4: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93012940. Source: OSTI; NTIS; GPO Dep.

The design of the Continuous Wave Deuterium Demonstrator (CWDD) and the status of the fabricated hardware is presented. The CWDD is a high brightness, 352 MHz, CW linear accelerator designed to deliver a 7.54 MeV, 80 mA D^- beam at a transverse normalized rms emittance of 0.11 π mm-mrad and a longitudinal rms emittance of 0.20 π mm-mrad. End-to-end beam dynamics analysis for nominal and off-design conditions is described. The tuning and predicted operational performance os the as-built device are also discussed. These results all indicate that the present design can meet the output performance specifications in the presence of combined errors at the limits of the specified engineering tolerances. Preliminary injector operations have been conducted at AEA Technologies, Culham Laboratory and at Argonne National Laboratory, where the CWDD is sited. Initial RGQ beam experiments at Argonne are projected for October 1993. DTL installation and commissioning will be completed in 1994.

26963 (BNL–48220) **Operation of the Brookhaven AGS with the Booster.** Weng, W.T. Brookhaven National Lab., Upton, NY (United States). [1993]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-930511–160: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93015405. Source: OSTI; NTIS; INIS; GPO Dep.

The Brookhaven Alternating Gradient Synchrotron (AGS) received protons directly from a Linac and heavy ions directly from a Tandem Van de Graaff before 1992. The newly constructed Booster has been brought on line to serve as an injector for the AGS. The operational status of the acceleration of proton and heavy ions through the Booster and the AGS is reviewed. Accelerator improvement programs to increase proton intensity for physics research and to prepare heavy ion beams for RHIC injection are discussed.

26964 (DOE/ER/40648–2) **Experimental and theoretical investigation of high gradient acceleration: Progress report, February 1, 1992–January 31, 1993.** Wurtele, J.S.; Bekefi, G.; Chen, C.; Chen, S.C.; Temkin, R.J. Massachusetts Inst. of Tech.,

Cambridge, MA (United States). Plasma Fusion Center. Jan 1993. 34p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-91ER40648. Order Number DE93015883. Source: OSTI; NTIS; INIS; GPO Dep.

This report contains a technical progress summary of the research conducted under the auspices of DOE Grant No. DE-AC02-91-ER40648, "Experimental and Theoretical Investigations of High Gradient Acceleration". This grant supports three research tasks: Task A consists of the design, fabrication and testing of a 17GHz RF photocathode gun, which can produce 2ps electron pulses with up to 1nC of charge at 2MeV energy and at a 1OHz repetition rate. Task B supports the testing of high gradient acceleration at 33GHz structure, and Task C comprises theoretical investigations, both in support of the experimental tasks and on critical physics issues for the development of high energy linear colliders.

26965 (ENEA-RTI-INN–92-20) **Autofocussing LINAC: ENEA study.** Picardi, L.; Ronsivalle, C.; Vignati, A. ENEA, Frascati (Italy). 1992. 16p. (In Italian). (RTI-INN–92-20). Order Number DE93799243. Source: OSTI; NTIS (US Sales Only); INIS.

Recent industrial demand for a mobile radiographic system has led to the study and development, by ENEA (the Italian Agency for New Technology, Energy and the Environment) and the IRVIN Electronics Company, of a 5 MeV radiographic LINAC operating in the S band. The necessity of having a compact system to drastically reduce the overall weight of the equipment led to the design of a dynamic autofocussing system which eliminates the need for the usual focalizing solenoid. This paper outlines the key design, operation and performance features of this compact LINAC.

26966 (FNAL/C–93/123) **Multibunch operation in the Tevatron Collider.** Holt, J.A.; Finley, D.A.; Bharadwaj, V. Fermi National Accelerator Lab., Batavia, IL (United States). May 1993. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. (CONF-930511–139: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014924. Source: OSTI; NTIS; INIS; GPO Dep.

The Tevatron Collider at Fermilab is the world's highest energy hadron collider, colliding protons with antiprotons at a center of mass energy of 1800 GeV. At present six proton bunches collide with six antiproton bunches to generate luminosities of up to 9 x 10^{30} $cm^{-2}s^{-1}$. It is estimated that to reach luminosities significantly greater than 10^{31} $cm^{-2}s^{-1}$ while minimizing the number of interactions per crossing, the number of bunches will have to be increased. Thirty-six bunch operation looks like the most promising plan. This paper looks at the strategies for increasing the number of particle bunches, the new hardware that needs to be designed and changes to the operating mode in filling the Tevatron. An interactive program which simulates the filling of the Tevatron collider is also presented. The time scale for multibunch operation and progress towards running greater than six bunches is given in this paper.

26967 (LAL-RT–93-01) **RF system options for the τ-C factory.** Huang Nan (Institute of High Energy Physics, Beijing, BJ (China). The Electron LINAC Dept.). Paris-11 Univ., 91 - Orsay (France). Lab. de l'Accelerateur Lineaire. Feb 1993. [42p.] Order Number DE93631021. Source: OSTI; NTIS (US Sales Only); INIS.

The properties of seven cavities are compared and three of them may be recommended for the τ-c factory. The simple approximate formulae to estimate the threshold impedances of couple-bunch instabilities for HOM resonances in RF cavities are given.

26968 (LA-UR–93-1387) **Future facilities for high-resolution (π, K) and other pion reactions at 1 GeV.** Thiessen, H.A.; Zumbro, J.D. Los Alamos National Lab., NM (United States). [1993]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930389–9: Future directions in particle and nuclear physics at multi-GeV hadron beam facilities, Upton, NY (United States), 4-6 Mar 1993). Order Number DE93012680. Source: OSTI; NTIS; INIS; GPO Dep.

In 1991, the LAMPF Users considered a facility based on a pion linac (PILAC) to provide pions of up to 1 GeV for (π, K) and other pion reactions at LAMPF. We have extended this proposal to a version appropriate for high-energy proton accelerators by raising the pion injection energy and shortening the pion linac so that it is used as a rf separator and bunch rotator (SCRUNCHER). We have then estimated the yield of pions on target expected at LAMPF (PILAC), LAMPF assuming a proton energy upgrade to 2 GeV at 1 mA, the proposed KAON facility at TRIUMF, the Brookhaven AGS with booster, and the Fermilab Main Injector.

26969 (LA-UR–93-1879) **Operation of the high brightness linac for the advanced free-electron laser initiative at Los Alamos.** Sheffield, R.L.; Austin, R.H.; Chan, K.C.D.; Gierman, S.M.; Kinross-Wright, J.M.; Kong, S.H.; Nguyen, D.C.; Russell, S.J.; Timmer, C.A. Los Alamos National Lab., NM (United States). [1993]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930511–42: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014471. Source: OSTI; NTIS; INIS; GPO Dep.

Free-electron lasers and high energy physics accelerators have increased the demand for very high-brightness beam sources. This paper describes the design of an accelerator which has produce beams of less than 2.1 π mm-mrad at 1 nC and emittances of 3.7 and 6.5 π mm-mrad for 2 and 3 nC, respectively. The accelerator has been operated between 10 and 18 MeV.The beam emittance growth in the accelerator is minimized by using a photoinjector electron source integrated into the design of the linac, a focusing solenoid to correct the emittance growth caused by space charge, and a special design of the coupling slots between accelerator cavities to minimize quadrupole effects.

26970 (LA-UR–93-2090) **Design study for a superconducting proton linac from 20 to 100 MeV.** Wangler, T.P.; Garnett, R.; Krawczyk, F.; Billen, J.; Bultman, N.; Christensen, K.; Fox, W.; Wood, R. Los Alamos National Lab., NM (United States). [1993]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930511–211: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93016626. Source: OSTI; NTIS; INIS; GPO Dep.

Advances in superconducting radiofrequency technology during the past 15 years have made possible the large-scale application of superconducting niobium accelerators. So far this development has been restricted to rather low-current electron and heavy-ion accelerators. In addition to the power savings, the improved capability of superconducting cavities to provide acceleration of high currents with low beam losses, which follows from the ability to use larger beam apertures without a large economic penalty from increased rf losses, could make superconducting proton linacs very attractive for high-intensity applications, where activation of the accelerator is a major concern. During the past year, at Los Alamos, the authors have been looking at a possible upgrade to the 800-MeV LAMPF proton accelerator, to provide higher intensity injection into a new storage ring for a new high-intensity pulsed neutron source. As part of this upgrade to the LAMPF accelerator, the entire linac below 100 MeV would be rebuilt to provide improved beam quality, improved reliability, and to include funneling at 20 MeV for higher beam currents. Both a room-temperature and a superconducting option are being considered for the section from 20 to 100 MeV. At present, this section is a 201.25 MHz room-temperature copper drift-tube linac (DTL). For this new upgrade scenario the frequency from 20 to 100 MeV was fixed at 805 MHz. The new duty factor is assumed to be 7.2%, and the authors show some results at two currents, 30 mA and 150 mA, that span the range of interest. Their superconducting linac concept consists of individual multicell cavities, each driven by a klystrode. Focusing would be provided by superconducting quadrupole lenses between cavities. In the remainder of the paper they describe their study to evaluate the potential of a superconducting proton linac section for this application, and address some of the many design choices.

26971 (LBL–33089) **The Bevalac long flattop.** Celata, C.M.; Abbott, S.; Bennett, M.; Bordua, M.; Calvert, J.; Dwinell, R.; Howard, D.; Hunt, D.; Feinberg, B.; Force, R.; Frias, R.; Kalnins, J.; Lewis, S.; Nyman, M.; Shalz, L.; Solomons, S.R.; Tekawa, M. Lawrence Berkeley Lab., CA (United States). Oct 1992. 46p. Sponsored by USDOE, Washington, DC (United States). DOE Contract

AC03-76SF00098. Order Number DE93015223. Source: OSTI; NTIS; INIS; GPO Dep.

Until July of 1992, the maximum length of the Bevalac flattop was 2 seconds, limiting the beam spill to 1.5 seconds. The normal running condition was a 1.5 second flattop, with a 1.0 second beam spill. If we define the duty factor as the spill length (in time) divided by the synchrotron pulse length, that is, the percentage of time the Bevalac can deliver beam to experiments, the duty factor for the 1.5 second flattop ranged from 17% (at full field, i.e., 12575 G) to 25% (low field). The purpose of the Long Flattop Project was to increase the length of the flattop, thus increasing the duty factor of the machine, and its efficiency for experiments. This has been done, with resultant increase in the duty factor and experimental data rate. It is now possible to run with duty factor of about 80% for low fields, falling to about 60% at 10 kG, and 34% at full field. This report documents what was done, and its limitations. It should be noted that increasing the length of the beam spill is only possible if the source can produce more beam per pulse than is usable by the experimenter. Experimenters running at full intensity with a short flattop (1.5 seconds) cannot benefit from a longer flattop. This paper describe the changes that have been made to Bevalac systems to make the long flattop possible, the limits put on the length of the flattop by existing hardware, and the procedure for tuning for the long flattop.

26972 (LBL–33664) **The development of colliders.** Sessler, A.M. Lawrence Berkeley Lab., CA (United States). Feb 1993. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-930293–2: International symposium on 30 years of neutral currents, Los Angeles, CA (United States), 3-5 Feb 1993). Order Number DE93013907. Source: OSTI; NTIS; INIS; GPO Dep.

Don Kerst, Gersh Budker, and Bruno Touschek were the individuals, and the motivating force, which brought about the development of colliders, while the laboratories at which it happened were Stanford, MURA, the Cambridge Electron Accelerator, Orsay, Frascati, CERN, and Novosibirsk. These laboratories supported, during many years, this rather speculative activity. Of course, many hundreds of physicists contributed to the development of colliders but the men who started it, set it in the right direction, and forcefully made it happen, were Don, Gersh, and Bruno. Don was instrumental in the development of proton-proton colliders, while Bruno and Gersh spearheaded the development of electron-positron colliders. In this brief review of the history, I will sketch the development of the concepts, the experiments, and the technological developments which made possible the development of colliders. It may look as if the emphasis is on theoretical concepts, but that is really not the case, for in this field – the physics of beams – the theory and experiment go hand in hand; theoretical understanding and advances are almost always motivated by the need to explain experimental results or the desire to construct better experimental devices.

26973 (SLAC-PUB–6097) **Chemical approaches to zero blowdown operation (TP93-05).** Geiger, G.E. (Betz Industrial, Trevose, PA (United States)); Ogg, J.; Hatch, M.R. Stanford Linear Accelerator Center, Menlo Park, CA (United States). Mar 1993. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00515. (CONF-9302124–1: 1993 Cooling Tower Institute annual meeting, New Orleans, LA (United States), 17-19 Feb 1993). Order Number DE93015252. Source: OSTI; NTIS; INIS; GPO Dep.

Zero blowdown operation was evaluated at a cooling tower at the Stanford Linear Accelerator Center in an attempt to eliminate cooling water discharge. Testing was performed with and without acid feed for pH control using a state-of-the-art treatment which contained polymer, phosphonate, and azole. Supplemental additional of a proprietary calcium carbonate scale inhibitor was also evaluated.

26974 (SSCL-Preprint–207) **The Superconducting Super Collider: A status report.** Schwitters, R.F. Superconducting Super Collider Lab., Dallas, TX (United States). Apr 1993. 21p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930511–56: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014062. Source: OSTI; NTIS; INIS; GPO Dep.

The design of the Superconducting Super Collider (SSC) is briefly reviewed, including its key machine parameters. The scientific objectives are twofold: (1) investigation of high-mass, low-rate, rare phenomena beyond the standard model; and (2) investigation of processes within the domain of the standard model. Machine luminosity, a key parameter, is a function of beam brightness and current, and it must be preserved through the injector chain. Features of the various injectors are discussed. The superconducting magnet system is reviewed in terms of model magnet performance, including the highly successful Accelerator System String Test Various magnet design modifications are noted, reflecting minor changes in the collider arcs and improved installation procedures. The paper concludes with construction scenarios and priority issues for ensuring the earliest collider commissioning.

26975 (SSCL-Preprint–217) **Business opportunities in the SSCL Global Control System.** Heefner, J.; Bork, R.; Gurd, D. Superconducting Super Collider Lab., Dallas, TX (United States). Apr 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930537–9: 5. annual international industrial symposium on the Super Collider and exhibition, San Francisco, CA (United States), 6-8 May 1993). Order Number DE93012302. Source: OSTI; NTIS; INIS; GPO Dep.

The SSC consists of a series of six accelerators: an injector complex made up of a LINAC, a Low Energy Booster (LEB), a Medium Energy Booster (MEB), and High Energy Booster (HEB), as well as two storage rings together known as the "Collider." Although controls requirements and issues related to this complex of accelerators are not inherently different from those of other large accelerator laboratories, some special problems result from the large number of control points involved (greater than 500,000), the great distances between the various components (up to 100 Km), and the very high reliability required (.986 availability for the global control system). The SSCL will employ an integrated control system, which at the highest level is called the Global Accelerator Control System (GACS). The GACS is defined as that system which provides the infrastructure and environment in which all systems directly affecting the accelerated beam are integrated, operated and controlled. The GACS is divided into two primary subsystems, Beam Controls and Process Controls. Beam Controls are those required to operate systems which directly support beam acceleration, steering, focusing and diagnostics. The precisely timed and synchronized, high speed, high quality Beam Controls are required only during beam operations. In contrast, the Process Controls operate independently, update at slower and do not require precise timing or synchronization.

26976 (SSCL-Preprint–253) **What the quality philosophy brings to a research and development environment like the SSC.** Davis, S.; Wentz, J. Superconducting Super Collider Lab., Dallas, TX (United States). Apr 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930537–12: 5. annual international industrial symposium on the Super Collider and exhibition, San Francisco, CA (United States), 6-8 May 1993). Order Number DE93014079. Source: OSTI; NTIS; INIS; GPO Dep.

In achieving major schedule and performance milestones with a project as technologically advanced as the Superconducting Super Collider, many activities must be coordinated simultaneously without the luxury of a conventional design review process. Because the design may change several times prior to the delivery of a one-of-a-kind or prototype component or subsystem, close verification and monitoring of design, manufacturing and test processes are needed on a real-time basis. This verification and monitoring is performed on two levels by Quality Assurance at the SSC Laboratory; Division and General Management. The Division level is involved in day-today activities at the Laboratory and the Suppliers; the General Management level performs the independent oversight function for all the Laboratory quality processes. In the divisions, continuous monitoring of design, procurement, manufacturing, installation, and testing activities is performed. At the General Management level, quality program development and implementation is evaluated within each division. Critical suppliers involved in system design, manufacturing, and testing are evaluated against contract and program requirements to assure systems safely perform their

intended functions. Responsibilities for quality are extended by the participation of the SSCL Quality Assurance Office in Accelerator Readiness Reviews (ARR) previously known as Operational Readiness Reviews (ORR) for each major machine developed and designed at the Laboratory. Quality Assurance promoted continuous awareness of DOE contract requirements, SSC Laboratory Quality Assurance requirements and the Safety Analysis Report requirements which is not an easy task in the scientific community. A result has been a new cooperative attitude in which physicists, scientists, engineers, safety and quality professionals can work together towards a common goal.

26977 (SSCL-Preprint–343) **Status of the SSC.** Johnson, D.E. Superconducting Super Collider Lab., Dallas, TX (United States). May 1993. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. Order Number DE93016184. Source: OSTI; NTIS; INIS; GPO Dep.

The Superconducting Super Collider (SSC) is a high-luminosity proton-proton colliding-beam accelerator, providing access to particle collision energies at least an order of magnitude greater than are available at existing facilities. The SSC will have a maximum energy of 40 TeV in the center-of-mass and a luminosity of $10^{33}cm^{-2}s^{-1}$ when completed. This paper will describe the current status of the design and construction of the SSC.

26978 (SSCL-Preprint–370) **The effect of global survey misalignment on the SSC.** Garavaglia, T.; Mahale, N.; Peterson, J. Superconducting Super Collider Lab., Dallas, TX (United States). May 1993. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930511–35: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014178. Source: OSTI; NTIS; INIS; GPO Dep.

Survey errors in the global alignment of the SSC can affect its performance. These errors can result in an uncertainty in the circumference of the collider, and this can produce a mismatch in the transfer of bunches from the HEB to the SSC. An uncertainty in the half-circumference of the Collider will reduce the luminosity. To estimate this effect, an expression is given for the luminosity as a function of crossing angle and half-circumference difference. In addition, estimates are given for closed orbit distortion, vertical dispersion, and tune shift, resulting from circumferential errors. Suggestions are made for correcting the effects resulting from global survey errors.

26979 (SSCL-Preprint–428) **Accelerator physics issues at the SSC.** Dugan, G.F. Superconducting Super Collider Lab., Dallas, TX (United States). May 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930511–206: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93016246. Source: OSTI; NTIS; INIS; GPO Dep.

Realization of the design energy and luminosity goals of the Superconducting Super Collider (SSC) will require proper resolutions of a number of challenging problems in accelerator physics. The status of several salient issues in the design of the SSC will be reviewed and updated in this paper. The emphasis will be on the superconducting accelerators.

4302 Beam Dynamics, Field Calculations, and Ion Optics

Refer also to citation(s) 26794, 27038, 27044, 27049, 27124, 27139, 27147, 27150, 27154, 27164, 27165, 28066, 28068, 28140

26980 (ANL/ASD/CP–78288) **Required cavity HOM deQing calculated from probability estimates of coupled bunch instabilities in the APS ring.** Emery, L. Argonne National Lab., IL (United States). [1993]. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-930511–147: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93015164. Source: OSTI; NTIS; INIS; GPO Dep.

A method of determining the deQing requirement of individual cavity higher-order modes (HOM) for a multi-cavity RF system is presented and applied to the APS ring. Since HOM resonator frequency values are to some degree uncertain, the HOM frequencies should be regarded as random variables in predicting the stability of the coupled bunch beam modes. A Monte Carlo simulation provides a histogram of the growth rates from which one obtains an estimate of the probability of instability. The damping of each HOM type is determined such that the damping effort is economized, i.e. no single HOM dominates the specified growth rate histogram.

26981 (ANL/ASD/CP–78298) **Establishment of a tolerance budget for the Advanced Photon Source storage ring.** Bizek, H.; Crosbie, E.; Lessner, E.; Teng, L. Argonne National Lab., IL (United States). [1993]. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-930511–148: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93015165. Source: OSTI; NTIS; INIS; GPO Dep.

The limitations on the dynamic aperture of the Advanced Photon Source storage ring due to magnet misalignments and fabrication errors are presented. The reduction of the dynamic aperture is analyzed first for each error considered individually, and then for combined error multipole fields in dipole, quadrupole, and sextupole magnets, excluding and including magnet misalignments. Since misalignments of the strong quadrupoles in the ring induce large orbit distortions, the effects on the dynamic aperture are investigated before and after orbit correction. Effects of off-momentum particles and the tune dependence with momentum are also presented. This extensive analysis leads to the establishment of a tolerance budget. With all the errors set at the tolerance level and with the orbit distortions corrected, the dynamic aperture reduction is no greater than 50% of that of the ideal machine.

26982 (BNL–48233) **A new formulation of longitudinal coherent instabilities.** Zhang, S.Y.; Weng, W.T. Brookhaven National Lab., Upton, NY (United States). [1993]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-930511–127: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014288. Source: OSTI; NTIS; INIS; GPO Dep.

The quadrature response of longitudinal impedance is shown to be the effective impedance for the beam instability. The results of the application of this formulation are compared with that obtained using the Robinson-Pedersen approach and the Sacherer integral equation. The formulation is further generalized to the rigid bunch motion using signal analysis method, where a form factor shows up naturally. Finally, the formulation is applied to solve the coupled bunch instabilities. Examples of the AGS Booster and the AGS coupled bunch instabilities are used to illustrate the applications of the formulation.

26983 (BNL–48235) **Wiggler as spin rotators for RHIC.** Luccio, A.; Conte, M. Brookhaven National Lab., Upton, NY (United States). [1993]. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-930511–74: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014312. Source: OSTI; NTIS; INIS; GPO Dep.

The spin of a polarized particle in a circular accelerator can be rotated with an arrangement of dipoles with field mutually perpendicular and perpendicular to the orbit. To achieve spin rotation, a given field integral value is required. The device must be designed in a way that the particle orbit is distorted as little as possible. It is shown that wigglers with many periods are suitable to achieve spin rotation with minimum orbit distortions. Wigglers are also more compact than more established structures and will use less electric power. Additional advantages include their use for non distructive beam diagnostics. Results are given for the Relativistic Heavy Ion Collider (RHIC) in the polarized proton mode.

26984 (BNL–48237) **Measurement of the spin of a particle using undulator radiation.** Luccio, A. Brookhaven National Lab., Upton, NY (United States). [1993]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-930511–75: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014334. Source: OSTI; NTIS; INIS; GPO Dep.

Use of many period wigglers to rotate the spin of particles in accelerators has been proposed. An added advantage of this scheme is that a spectrum of synchrotron radiation will be produced that contains a contribution due to the spin, so that the device can be effectively used as spin polarimeter, with advantages compared to Compton backscattering methods. Results are presented for two high energy proton storage rings: RHIC and the SSC.

26985 (BNL–48239) **Time domain solutions for a coasting beam with impedance feedback.** Blaskiewicz, M. Brookhaven National Lab., Upton, NY (United States). [1993]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-930511–125: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014296. Source: OSTI; NTIS; INIS; GPO Dep.

Time domain solutions for a coasting beam interacting with a longitudinal or transverse impedance are presented. The treatment is limited to first order perturbation theory, but it includes Landau damping.

26986 (BNL–48240) **Longitudinal impedance and stability thresholds of the AGS Booster.** Blaskiewicz, M. Brookhaven National Lab., Upton, NY (United States). [1993]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-930511–159: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93015407. Source: OSTI; NTIS; INIS; GPO Dep.

The various sources of longitudinal impedance in the AGS Booster are identified and the effects of the total impedance are estimated. In particular, the parasitic effects of the rf cavities during proton acceleration are explored. Dynamics are treated using a first order Vlasov analysis in the weak synchrotron coupling approximation.

26987 (BNL–48373) **Confinement and stability of a Crystal Beam.** Ruggiero, A.G. Brookhaven National Lab., Upton, NY (United States). [1993]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-930511–152: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93015400. Source: OSTI; NTIS; INIS; GPO Dep.

The following is an analysis of the confinement and stability issues of a Crystal Beam. A method is described to determine the equilibrium configuration of a beam of highly charged particles. It is required that the beam has a uniform distribution in the direction of motion, which is stable and does not need therefore confinement with external means. It is shown that this can be obtained only for a relatively longitudinally compact beam. Confinement in the plane transverse to the direction of motion is obtained with external means, which also provide stability. It is important that particles are distributed so that the resulting space charge forces are linear with respect to the particle transverse coordinates.

26988 (BNL–48374) **Nuclear fusion of protons with ions of boron.** Ruggiero, A.G. Brookhaven National Lab., Upton, NY (United States). [1993]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-930511–124: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014284. Source: OSTI; NTIS; INIS; GPO Dep.

This paper describes a method of extracting energy from the fusion events occurring between the collision of a beam of protons with a beam of ions of Boron 11. The two beams are circulating in separated and intersecting storage rings where they collide beadon in a common long-straight section. Requirements on the luminosity of the low-energy collider are shown. Limitations due to space-charge and intrabeam scattering are described. Very fast electron cooling is needed to compensate these effects.

26989 (BNL–48375) **Broadband impedance of azimuthally symmetric devices in RHIC.** Mane, V. Brookhaven National Lab., Upton, NY (United States). [1993]. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-930511–72: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014329. Source: OSTI; NTIS; INIS; GPO Dep.

The interaction between the beam and its environment leads to beam instabilities, and is characterized by coupling impedance. The longitudinal coupling impedance of some RHIC devices with azimuthal symmetry such as bellows, pipe transition, gate valve and collimator have been calculated numerically using the time domain code TBCI. The objective is to keep the broadband impedance below a threshold so that it satisfies the microwave stability criteria; and make sure there is no contribution to narrowband impedance from any of these structures.

26990 (BNL–48386) **Comparison of aperture determinations on RHIC for single particles tracked 10^6 turns and 100 particles, having randomly generated initial coordinates, tracked for 1000 turns.** Dell, G.F. Brookhaven National Lab., Upton, NY (United States). [1993]. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-930511–155: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93015401. Source: OSTI; NTIS; INIS; GPO Dep.

Aperture determinations from 100 particles tracked for 1000 turns using randomly selected initial coordinates are compared with results from 10^6 turn runs when initial coordinates are defined by $\epsilon_x = \epsilon_y$ and $X_i' = Y_i' = 0$. Measurements were made with ten distributions of magnetic field errors. The results from tracking 100 particles for 10^3 turns are equivalent to those from 10^6 turn runs, have a distribution of considerably less width, and require only one tenth the computer time.

26991 (BNL–48388) **Software development with two port calibration techniques for RHIC impedance measurements.** Mane, V.; Shea, T. Brookhaven National Lab., Upton, NY (United States). [1993]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-930511–73: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014328. Source: OSTI; NTIS; INIS; GPO Dep.

The coupling impedance of accelerator devices is measured by simulating the beam with a central wire and measuring the scattering parameters of the system. The wire pipe system forms a mismatch with the 50 ohm transmission line. An integrated software environment has been developed in LabVIEW, for the Macintosh. The program measures the scattering parameters of some known standards, determines the connect scattering parameters of a device using TRL calibration technique and gives the impedance of the device. Its performance has been tested for some known microwave devices.

26992 (BNL–48894) **A γ_t-jump scheme for the Brookhaven AGS.** Ahrens, L.; Auerbach, E.; Hardt, W.; Raka, E.; Ratner, L.; Yamin, P. Brookhaven National Lab., Upton, NY (United States). 23 Apr 1993. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. Order Number DE93014301. Source: OSTI; NTIS; INIS; GPO Dep.

Accelerator Division technical note No. 265.

AGS beam losses at transition are now tolerable (<5%), but as the present improvement plans are implemented and the intensity is increased, new mechanisms will become important and the losses will increase. This Note describes studies directed towards minimizing these losses. Werner Hardt has studied these losses at the CERN PS. In particular, he found that by sharply reducing the time spent going through transition he could reduce the losses. Hardt visited Brookhaven in early June, 1986, in order to help us better understand the AGS. As a result of work inspired by his visit, we now believe that intensities of $\sim 5 \times 10^{13}$ circulating protons are attainable in the AGS without significant losses at transition.

26993 (BNL–48958) **Wake-field and space charge effects on high brightness beams calculations and measured results for the laser driven photoelectrons at BNL-ATF.** Parsa, Z. Brookhaven National Lab., Upton, NY (United States). May 1993. 53p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CAP–95-ATF-93C;CONF-9109349–2: Accelerator physics and modeling, Upton, NY (United States), 17 Sep 1991). Order Number DE93015787. Source: OSTI; NTIS; INIS; GPO Dep.

We discuss the formalism used to study the effects of the interactions between the highly charged particles and the fields in the accelerating structure, including space charge and wake fields. Some of our calculations and numerical simulation results obtained for the Brookhaven National Laboratory (BNL) high-brightness photoelectron beam at the Accelerator Test Facility (ATF) and the measured data at ATF are also included.

26994 (CEA-LNS-GT–92-09) **Numerical simulation of spin motion in circular accelerators using spinor formulation.** Nghiem, P.; Tkatchenko, A. Laboratoire National Saturne - Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Jul 1992. [31p.] Order Number DE93631091. Source: OSTI; NTIS (US Sales Only); INIS.

A simple method is presented based on spinor algebra formalism for tracking the spin motion in circular accelerators. Using an analytical expression of the one-turn transformation matrix including the effects of perturbating fields or of siberian snakes, a simple and very fast numerical code has been written for studying spin motion in various circumstances. In particular, effects of synchrotron oscillations on final polarization after one isolated resonance crossing are simulated. Results of these calculations agree very well with those which have been obtained previously from analytical approaches or from other numerical-simulation programs. (author) 8 refs.; 14 figs.

26995 (CEA-LNS-GT-ME–92-08) **Spreader and recombiner for 15-30 GeV electron accelerator.** Doornbos, J. Laboratoire National Saturne - Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Mar 1992. [20p.] Order Number DE93631090. Source: OSTI; NTIS (US Sales Only); INIS.

The spreader and the recombiner systems for a linear accelerator are described in detail. The beams in the spreader and recombiner have to be matched on one side to the beams in the linac and on the other to the beams in the arcs. The beam forming system and the optical arrangement of the spreader and recombiner is described, and beam dynamical calculations are presented. (K.A.) 16 figs.

26996 (DOE/ER/40374–72) **Research in accelerator physics (Theory): Final technical report, May 15, 1992–May 14, 1993.** Ohnuma, S. Houston Univ., TX (United States). 10 Jun 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-87ER40374. Order Number DE93014765. Source: OSTI; NTIS; INIS; GPO Dep.

Work during the period November 1, 1992 through May 14, 1993 emphasized the following topics: final test of HESQ as a transport element at the SSC, analytical studies of Taylor maps for symplectic systems, and physics of magnet sorting in large rings. Earlier work has already been reported.

26997 (DOE/ER/40747–2) **Minimizing linear coupling in AGS with skew quads.** Huang, H. (Indiana Univ., Bloomington, IN (United States). Dept. of Physics); Lee, S.Y.; Ratner, L.G. Indiana Univ., Bloomington, IN (United States). Dept. of Physics. [1993]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-92ER40747. Order Number DE93017206. Source: OSTI; NTIS; INIS; GPO Dep.

Skew quadrupoles and solenoids can introduce linear betatron coupling into the beam. Since the linear coupling causes emittance growth, it should be minimized. Linear coupling caused by a solenoid can be corrected with skew quadrupoles by minimizing the coupling coefficient. It requires two orthogonal skew quadrupole families. The major source of linear coupling arises from the 5% partial solenoidal snake to be installed in the section I10 of the AGS. To correct the effect of linear coupling, 4 families of skew quadrupoles are proposed. 3 figs.

26998 (ENEA-RT-INN–92-31) **Analysis of optical-Klystron gain depression induced by inhomogeneous broadening effects.** Ciocci, F.; Dattoli, G.; Giannessi, L.; Torre, A. ENEA, Frascati (Italy). Dipt. Sviluppo Tecnologie di Punta. Dec 1992. 21p. (RT/INN–92-31). Order Number DE93799302. Source: OSTI; NTIS (US Sales Only); INIS.

Optical-Klystron (O.K.) configuration have been successfully exploited to enhance the gain of free electron lasers operating with storage rings. With the aim of presenting simple formulae which may be helpful in designing an actual O.K., this paper analyzes the modification induced in the Optical- Klystron gain by an e-beam with non-negligible energy spread and emittances. The analysis is carried out including the inhomogeneous broadening contributions due to the undulators and dispersive parts. The paper deals essentially with the low gain regime. The corrections due to the high gain effects are also discussed.

26999 (ETDE-IT–93-194) **High gain optical klystron.** Dattoli, G.; Galli, M.; Ottaviani, P.L.; Torre, A. ENEA, Frascati (Italy). Dipt. Sviluppo Tecnologie di Punta. 1992. 19p. Order Number DE93799299. Source: OSTI; NTIS (US Sales Only); INIS.

This paper analyzes the high-gain optical klystron regime, and discusses the conditions under which deviations occur from the linear theory. It shows that scaling relations, of the same type exploited for the conventional FEL (free electron laser) gain, hold for optical-klystron devices. It also explores problems related to inhomogeneous broadening gain reduction and finds that, analogous to conventional FEL's, the high gain corrections to optical-klystron operation are more severely reduced than the linear contributions.

27000 (FNAL/C–93/119) **Transition crossing in the Fermilab Main Ring, past and present.** Kourbanis, I.; Ng, K.Y. Fermi National Accelerator Lab., Batavia, IL (United States). May 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. (CONF-930511–140: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014923. Source: OSTI; NTIS; INIS; GPO Dep.

A recent installation of passive mode dampers in the Booster has eliminated most of the longitudinal emittance blowup of intense bunches due to coupled-bunch instabilities. As a result, high intensity effects (negative-mass instability) dominate the present transition crossing in the Main Ring for the high-intensity cycles. A negative-mass stability limit is derived for transition crossing in the Main Ring and recent observations of high frequency signals around transition is presented. Finally, some predictions about the effect of the negative mass instability on the transition in the Main Ring with the future upgrades are attempted.

27001 (FNAL/C–93/126) **Observation of the coalescing of beam into an asymmetric rf bucket by stochastic cooling.** Halling, A.M.; Lu, Xian Ping. Fermi National Accelerator Lab., Batavia, IL (United States). May 1993. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. (CONF-930511–135: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93015133. Source: OSTI; NTIS; INIS; GPO Dep.

Antiprotons in the debuncher ring at Fermilab have been observed to be bunched outside of the "barrier bucket" when cooled to small $\Delta p/p$ with the stochastic cooling. This bunching occurs in the same location as a very small stable bucket in the RF wave form. The stochastic cooling appears to be causing beam that is originally uniformly distributed to be captured by this stable bucket.

27002 (FNAL/C–93/130) **The appearance of beam lines.** Carey, D.C. Fermi National Accelerator Lab., Batavia, IL (United States). May 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. (CONF-930511–162: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93015533. Source: OSTI; NTIS; INIS; GPO Dep.

The combination of an existing graphics package with a large program like TRANSPORT has often resulted in considerable modification to the large program. Use of other graphics package has resulted in essentially having to repeat the work. This difficulty has been avoided in a modification of TRANSPORT which produce layouts of beam lines. Drawings of the reference trajectory and three-dimensional images of all magnets are made by the graphics package TOP DRAWER. Nothing specific to TOP DRAWER or any other graphics has been incorporated into TRANSPORT. If a user is with a different graphics package he or she can then begin usage of this alternate package essentially immediately.

27003 (FNAL/C–93/135) **Automatic differentiation of limit functions.** Michelotti, L. Fermi National Accelerator Lab., Batavia, IL (United States). May 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. (CONF-930511–209: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93016376. Source: OSTI; NTIS; INIS; GPO Dep.

Automatic differentiation can be used to evaluate the derivatives of and set up Taylor series for implicitly defined functions and maps. The author provides several examples of how this works, within the context of the MXYZPTLK class library, and discusses its extension to inverse functions. The techniques of automatic differentiation and differential algebra are rapidly becoming a standard part of accelerator physicists' arsenals.

27004 (GANIL-P–92-28) **Secondary beams at GANIL.** Doubre, H. (Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France)). Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France). 1992. [14p.] Order Number DE93631092. Source: OSTI; NTIS (US Sales Only); INIS.

GANIL, a user's facility since 1983, can deliver a broad spectrum of heavy-ion beams, from He to U, to well-equipped experimental areas. Their very large intensities are to be exploited to produce secondary beams, either using the fragmentation method (beams at energy per nucleon larger than 30 MeV/u), or the ISOL method. With the latter one, these ions have to be re-accelerated. The project of a cyclotron as a post-accelerator is described. (author) 11 refs.; 7 figs.; 3 tabs.

27005 (IFVE-OKU–92-94) **Particle bunch forming in IHEP PS for UNK colliding beams.** Myaeh, Eh.A.; Nelipovich, E.S.; Pashkov, P.T.; Smirnov, A.V. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov (Russian Federation). Inst. Fiziki Vysokikh Ehnergij. 1992. [12p.] (In Russian). Order Number DE93628250. Source: OSTI; NTIS (US Sales Only); INIS.

A possibility to form in the IHEP machine the particle bunches whose longitudinal parameters would satisfy (0.4x3) TeV p-p program is analyzed. The compensation method of the RF voltage induced on the accelerating cavities when stretching the beam is suggested. The second and the fourth RF harmonics are used to extend the linearity domain of the accelerating field and, in consequence, to diminish bunch distortions during the subsequent compression process. The main parameters of the RF system needed for the creation the RF harmonics in the IHEP PS have been calculated as well. 6 refs.; 2 figs.; 1 tab.

27006 (IFVE-OUNK–91-141) **Bunch compression in the U-70 prior to beam extraction to provide UNK operation in beam colliding mode.** Balbekov, V.I.; Malovitskij, A.Yu. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov (Russian Federation). Inst. Fiziki Vysokikh Ehnergij. 1991. [15p.] (In Russian). Order Number DE93629613. Source: OSTI; NTIS (US Sales Only); INIS.

Bunch compression technique is considered which is supposed to be done before the beam transfer from the U-70 to be UNK. The latter is supposed to operate in the (0.4x3) TeV beam colliding mode. The technique includes the mismatching of the beam prior to its rotation in phase space around the stable fixed point. In addition to microwave instability two main problems are treated in detail - the nonlinearity of the synchrotron motion and the interaction of the beam with the RF cavities during the compression. Possible cures are investigated such as using an harmonic cavity at double of the RF frequency in order to linearise the main voltage. Also the suppression of the 1-st harmonic of the beam current is shown to be necessary for successful compression of the bunch. The influence of higher-order harmonic of the induced voltage is evaluated. 6 refs.; 9 figs.; 2 tabs.

27007 (IFVE-OUNK–91-158) **Beam-chamber interaction in accelerators. Methods for calculating coupling impedances.** Kurennoj, S.S. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov (Russian Federation). Inst. Fiziki Vysokikh Ehnergij. 1991. [63p.] (In Russian). Order Number DE93629614. Source: OSTI; NTIS (US Sales Only); INIS.

A review of methods for calculating the coupling impedances of the vacuum chamber of accelerators is given. The definitions of the coupling impedances, their properties and relations to the wake potentials are discussed in detail. The main attention is paid to the techniques applied at low frequencies and in the resonant region. An attempt to classify these methods is made. The paper presents a collection of formulae and can be used as a reference guide. 126 refs.; 1 fig.; 1 tab.

27008 (IFVE-OUNK–92-69) **Magnetic field quality in the pilot industrial batch's SC dipoles for the UNK.** Bal'bekov, V.I. (and others); Gertsev, K.F.; Zlobin, A.V. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov (Russian Federation). Inst. Fiziki Vysokikh Ehnergij. 1992. [15p.] (In Russian). Order Number DE93628251. Source: OSTI; NTIS (US Sales Only); INIS.

Now the pilot industrial batch of superconducting magnets is being manufactured at IHEP. The magnetic measurements of 25 dipoles have been performed. This paper contains the measured characteristics of the field quality: systematic and r.m.s. values of nonlinearities and field integral as functions of the supply current. The defects of these field errors on betatron tune spread and an increase of beam emittances are determined. The features of the UNK correction systems for this magnetic field quality are analyzed. 13 refs.; 5 tabs.

27009 (JAERI-M–92-211) **Properties of the transfer matrices of deflecting magnet systems for free electron laser.** Takao, Masaru (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment). Japan Atomic Energy Research Inst., Tokyo (Japan). Jan 1993. 17p. (In Japanese). Order Number DE93508257. Source: OSTI; NTIS; INIS.

The oscillation of the free electron laser (FEL) requires the high current and low emittance electron beam. The beam transport system should be achromatic and isochronous to preserve the brightness and the emittance of the electron beam. In this paper we clarify the algebraic properties of the transfer matrices of the magnetic deflection system, which is a key component in the beam transport line. (author).

27010 (JINR-E–9-92-227) **Eigenpotentials of self-consistent cylindrical Brillouin relativistic electron beam (REB).** Matora, I.M. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Neutron Physics. 1992. [10p.] Order Number DE93629615. Source: OSTI; NTIS (US Sales Only); INIS.

Submitted to Nucl. Instrum. Methods.

The calcualtion results are given of the vector and scalar eigenpotentials in the self-consistent, high-current, cylindrical Brillouin REB and of its other radius dependent parameters. In combination with well-known earlier results on other dependences and constant values in these REB's and with the exact relativistic equation for electron trajectories in axisymmetrical laminar REB's, the data of this work could be applied to exact calculations of self-consistent cylindrical Brillouin REB formation. 4 refs.; 1 tab.

27011 (LA-UR–93-1686) **Beam halo in high-intensity beams.** Wangler, T.P. Los Alamos National Lab., NM (United States). [1993]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930269–14: Computational accelerator physics conference (CAP93), Pleasanton, CA (United States), 22-26 Feb 1993). Order Number DE93014565. Source: OSTI; NTIS; INIS; GPO Dep.

In space-charge dominated beams the nonlinear space-charge forces produce a filamentation pattern, which in projection to the 2-D phase spaces results in a 2-component beam consisting of an inner core and a diffuse outer halo. The beam-halo is of concern for a next generation of cw, high-power proton linacs that could be applied to intense neutron generators for nuclear materials processing. The author describes what has been learned about beam halo and the evolution of space-charge dominated beams using numerical simulations of initial laminar beams in uniform linear focusing channels. Initial results are presented from a study of beam entropy for an intense space-charge dominated beam.

27012 (LA-UR–93-1816) **Design for low beam loss in accelerators for intense neutron source applications.** Jameson, R.A.

Los Alamos National Lab., NM (United States). [1993]. 6p. Sponsored by USDOE, Washington, DC (United States); Japan Atomic Energy Research Inst., Tokyo (Japan). DOE Contract W-7405-ENG-36. (CONF-930511–82: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014557. Source: OSTI; NTIS; INIS; GPO Dep.

Control of beam loss in intense ion linacs involves keeping beam spill below parts in 10^{-5}–10^{-8}/m by preventing total beam size from extending to the limiting apertures. Starting from good rms design practices, new analysis of the machine architecture is described in terms of the effects of the machine tune with space-charge, free-energy constraint, and halo-producing mechanisms. It is shown that halos are produced by the time- (or position-) varying nature of common linac aspects (such as misalignment, mismatching, acceleration, and construction techniques) through collective core/single-particle interaction dynamics plus resonances.

27013 (LA-UR–93-1919) **Beam halo formation from space-charge dominated beams in uniform focusing channels.** O'Connell, J.S. (Booz, Allen and Hamilton, Inc., Arlington, VA (United States)); Wangler, T.P.; Mills, R.S.; Crandall, K.R. Los Alamos National Lab., NM (United States). [1993]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930511–49: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014458. Source: OSTI; NTIS; INIS; GPO Dep.

In space-charge dominated beams the nonlinear space-charge forces produce a filamentation pattern, which results in a 2-component beam consisting of an inner core and an outer halo. The halo is very prominent in mismatched beams, and the potential for accelerator activation is of concern for a next generation of cw, high-power proton linacs that could be applied for intense neutron generators to process nuclear materials. We present new results about beam halo and the evolution of space-charge dominated beams from multiparticle simulation of initial laminar beams in a uniform linear focusing channel, and from a model consisting of single particle interactions with a uniform-density beam core. We study the energy gain from particle interactions with the space-charge field of the core, and we identify the resonant characteristic of this interaction as the basic cause of the separation of the beam into the two components. We identify three different particle-trajectory types, and we suggest that one of these types may lead to continuous halo growth, even after the halo is removed by collimators.

27014 (LBL–32435-Draft) **Closed orbit distortion and the beam-beam interaction.** Furman, M. (Lawrence Berkeley Lab., CA (United States)); Chin, Y.H.; Eden, J.; Kozanecki, W.; Tennyson, J.; Ziemann, V. Lawrence Berkeley Lab., CA (United States). 1 Jun 1992. 48p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (ESG–193;SLAC-ABC–49). Order Number DE93015284. Source: OSTI; NTIS; INIS; GPO Dep.

We study the applicability of beam-beam deflection techniques as a tuning tool for the SLAC/LBL/LLNL B factory, PEP-II. Assuming that the closed orbits of the two beams are separated vertically at the interaction point by a local orbit bump that is nominally closed, we calculate the residual beam orbit distortions due to the beam-beam interaction. Difference orbit measurements, performed at points conveniently distant from the IP, provide distinct coordinate- or frequency-space signatures that can be used to maintain the beams in collision and perform detailed optical diagnostics at the IP. A proposal to test this method experimentally at the TRISTAN ring is briefly discussed.

27015 (LBL–33091) **User's guide for New ABCI version 6.2: Azimuthal Beam Cavity Interaction.** Chin, Yong Ho. Lawrence Berkeley Lab., CA (United States). Nov 1992. 52p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CERN-SL–92-49(AP);ESG–216). Order Number DE93015294. Source: OSTI; NTIS; INIS; GPO Dep.

ABCI described here is a computer program which solves the Maxwell equations directly in the time domain when a Gaussian beam goes through an axi-symmetrical structure on or off axis. Many new features have been implemented in this version of ABCI, including the "moving mesh" and Napoly's method of calculation of wake potentials. The mesh is now generated only for the part of the structure inside a window, and moves together with the window frame. This moving mesh option drastically reduces the number of mesh points, and therefore allows calculation of wake potentials in very long structures and/or for very short bunches. In terms of Napoly's integration method, the calculation of transverse and longitudinal wake potentials in a structure such as a collimator, where parts of the cavity material come down below the beam pipe radius, can be carried out now correctly with beam pipes of short length at both ends. For the monopole wake potential, ABCI can be applied even with structures with unequal beam pipe radii. A newly installed mesh generator performs automatic circular and elliptical connections of input points just as TBCI does. In addition to the conventional method, ABCI permits the input of the structure geometry by giving the increments of coordinates from the previous positions. In this method, one can use the repetition commands to repeat input blocks when the same structure repeats many times. Plots of a cavity shape and wake potentials can be obtained in the form of a Top Drawer file. ABCI is available as a source code in the CERN IBM VM/CMS system.

27016 (SAND–93-7067C) **Beam emittance from coherent Cherenkov radiation in a solid dielectric.** Richardson, R.D. (Science Applications International Corp., Albuquerque, NM (United States)); Platt, R.C.; Crist, C.E. Sandia National Labs., Albuquerque, NM (United States). [1993]. 10p. Sponsored by USDOE, Washington, DC (United States); Department of Defense, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-930511–158: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93015022. Source: OSTI; NTIS; INIS; GPO Dep.

We report experimental insults of a technique for direct measurement of the emittance in high energy beams. This technique is analogous to the well known "pepper pot" masking approach, but with no upper limit on particle energy. Single shot emittance profiles were obtained on the 10 kA, 4 MeV SNL electron Recirculating Linear Accelerator showing agreement with theory and with alternate emittance measurements. Coherent (i.e., not strongly scattered or diffused) Cherenkov radiation from a flat, transparent, range-thin dielectric foil was split by an array of mirrors in order to view the emission profile up to a divergence angle of 70°. The mirrors were imaged by a distant telescope attached to an intensified, 2 ns video framing camera. The relative intensity profiles of the multiple images were unfolded using the properties of classical Cherenkov emission and geometric optics to obtain directly, without precise knowledge of other beam parameters, the transverse velocity distribution in the viewing plane. In our case the rms emittance was directly proportional to the product of the beam diameter and the transverse velocity spread. This and prior research efforts indicate applicability over a wide range of high energy beam parameters.

27017 (SLAC-PUB–6123) **Broadband impedance of the B factory.** Heifets, S. Stanford Linear Accelerator Center, Menlo Park, CA (United States). Apr 1993. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00515. (CONF-930511–164: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93015602. Source: OSTI; NTIS; INIS; GPO Dep.

The broadband impedance is described phenomenologically by expansion over $\sqrt{\omega}$. It is shown that different terms of the expansion correctly describe particular impedance-generating elements. The broadband impedance and the wake function of the B factory are reconstructed with numeric code TBCI. The losses at the interaction region due to excitation of the higher order modes (HOM) are estimated.

27018 (SSCL–614) **Simulation studies of the transverse dipole mode multibunch instability for the SSC Collider.** Chen, S.; Lopez, G. Superconducting Super Collider Lab., Dallas, TX (United States). Jan 1993. 42p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. Order Number DE93016044. Source: OSTI; NTIS; INIS; GPO Dep.

A computer program that assumes a point-like structure of the bunches, called TADIMMI, has been devised to study the dipole mode multibunch instability in the Superconducting Super Collider (SSC) Collider ring due to a single Positron-Electron Project (PEP) test rf cavity and the resistive wall. For the rf cavity, the following cases are considered: symmetric filling, where good agreement is

obtained with ZAP code; nonsymmetric filling; elimination of the most dangerous mode of the cavity; De-Q of the cavity, where a damping ratio is obtained for the cavity; and the feedback system, where it is verified that the proposed system for the Collider will work. For the resistive wall, a resonator impedance model approximation is used, which allows use of the same computer program to study the instabilities and the associated feedback system. Comparison with the analytical approach (ZAP) is also made.

27019 (SSCL-Preprint–149-Rev.2) **A parallel implementation of particle tracking with space charge effects on an INTEL IPSC/860.** Chang, L.; Bourianoff, G.; Cole, B.; Machida, S. Superconducting Super Collider Lab., Dallas, TX (United States). May 1993. 25p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930511–54-Rev.2: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014163. Source: OSTI; NTIS; INIS; GPO Dep.

Particle-tracking simulation is one of the scientific applications that is well-suited to parallel computations. At the Superconducting Super Collider, it has been theoretically and empirically demonstrated that particle tracking on a designed lattice can achieve very high parallel efficiency on a MIMD Intel iPSC/860 machine. The key to such success is the realization that the particles can be tracked independently without considering their interaction. The perfectly parallel nature of particle tracking is broken if the interaction effects between particles are included. The space charge introduces an electromagnetic force that will affect the motion of tracked particles in 3-D space. For accurate modeling of the beam dynamics with space charge effects, one needs to solve three-dimensional Maxwell field equations, usually by a particle-in-cell (PIC) algorithm. This will require each particle to communicate with its neighbor grids to compute the momentum changes at each time step. It is expected that the 3-D PIC method will degrade parallel efficiency of particle-tracking implementation on any parallel computer. In this paper, we describe an efficient scheme for implementing particle tracking with space charge effects on an INTEL iPSC/860 machine. Experimental results show that a parallel efficiency of 75% can be obtained.

27020 (SSCL-Preprint–238) **Echo effect in accelerators.** Stupakov, G.; Kauffmann, K. Superconducting Super Collider Lab., Dallas, TX (United States). May 1993. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930511–32: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014138. Source: OSTI; NTIS; INIS; GPO Dep.

The echo effect has been known for many years in different fields of physics. Examples are the spin echo in solids, photon echo in solids and gases, plasma wave echo, and the echo in a liquid with gas bubbles. The media that exhibit the echo characteristically consist of (or contain in them) an ensemble of oscillators with different eigenfrequencies and negligibly small dissipation. An initial perturbation applied to such a medium excites oscillations (or waves) that slowly damp due to dephasing. This kind of damping differs essentially from that which would result from a dissipative mechanism; in particular, dephasing does not increase the entropy of the medium. It has the remarkable feature that even after the oscillations are completely damped out, the system keeps a "recollection" about them, and a special kind of a disturbance applied to the medium can transiently restore the oscillations in the form of an echo signal. The betatron echo in a hadron accelerator can be observed in a situation where the beam is injected off-center into the ring at time $n = 0$ (n is the time measured in the number of turns), causing its centroid to undergo betatron oscillations. After these oscillations have completely damped out due to beam decoherence, the beam is excited by a quadrupole kick at time $n = n_1$. This kick does not produce any visible displacement of the beam at that time, but it turns out that close to time $n = 2n_1$, the beam centroid undergoes transient betatron oscillations with an amplitude which is a fraction of the initial beam offset.

27021 (SSCL-Preprint–367) **The provision of IP crossing angles for the SSC.** Nosochkov, Y. (Superconducting Super Collider Lab., Dallas, TX (United States)); Ritson, D. Superconducting Super Collider Lab., Dallas, TX (United States). May 1993. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930511–27: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014264. Source: OSTI; NTIS; INIS; GPO Dep.

Luminosity is to be produced at the SSC collider by crossing with finite angle the counter circulating proton beams at each interaction point (IP). Such a crossing angle introduces unwanted dispersion in the high beta triplet quadrupoles adjacent to the IPs which must be corrected out. We propose to produce variable crossing conditions at each IP with local steering dipoles adjusted to give required slopes and displacements for each IP. The anomalous dispersion introduced by these orbit displacements will be corrected in the arcs (dispersive region) just prior to entry and exit into the IPs with opposite polarity quadrupole pairs separated by 900 in phase, a "late" correction scheme. Such pairs cause minimal change to the betatron functions but produce dispersion that can be set to cancel the anomalous dispersion. The IR design is such that the phase advance between correctors and the IP triplet gives efficient full local anomalous dispersion cancellation. The proposed system is to be formed from standard SSC corrector elements and will provide the range of crossing conditions required for collision optics and for separating the beams at injection.

27022 (SSCL-Preprint–368) **Current design of the SSC Interaction Regions.** Nosochkov, Y. (Superconducting Super Collider Lab., Dallas, TX (United States)); Garren, A.; Sen, T.; Stiening, R.; Courant, E.; Ritson, D.M. Superconducting Super Collider Lab., Dallas, TX (United States). May 1993. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930511–131: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014262. Source: OSTI; NTIS; INIS; GPO Dep.

We review the important changes made to the optics of the Interaction Regions (IRs) in the collider since the conceptual design (SCDR) of 1990. The most significant modification is a new procedure for the β squeeze. Three additional families of independently powered quadrupoles change the optics from injection to collision while the strengths of the final focus triplet quadrupoles are held constant. The phase advance from the interaction point (IP) to the arc quadrupoles is optimized to provide more effective positions of the local correctors for the IR. Two secondary foci where the IP is imaged have been incorporated symmetrically on both sides of the IP. Other changes include a significant reduction in the β_{peak} at injection, optimized configuration of the $M = -I$ section, quadrupoles with 5 cm bore, minimized number of quad families, standard design of the vertical bends and reduced total length of the magnets. The optics allows for a wide range of values for a detector space at each IP. The time scenario for the β squeeze is considered as well.

27023 (SSCL-Preprint–369) **Decoupling schemes for the SSC Collider.** Cai, Y.; Bourianoff, G.; Cole, B.; Meinke, R.; Peterson, J.; Pilat, F.; Stampke, S.; Syphers, M.; Talman, R. Superconducting Super Collider Lab., Dallas, TX (United States). May 1993. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930537–45: 5. annual international industrial symposium on the Super Collider and exhibition, San Francisco, CA (United States), 6-8 May 1993). Order Number DE93014069. Source: OSTI; NTIS; INIS; GPO Dep.

A decoupling system is designed for the SSC Collider. This system can accommodate three decoupling schemes by using 44 skew quadrupoles in the different configurations. Several decoupling schemes are studied and compared in this paper.

27024 (SSCL-Preprint–372) **Longitudinal instabilities in the MEB.** Palkovic, J.A. Superconducting Super Collider Lab., Dallas, TX (United States). May 1993. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930511–108: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014067. Source: OSTI; NTIS; INIS; GPO Dep.

In this paper longitudinal instability parameters are calculated for the SSC Medium Energy Booster (MEB). Both single and multiple bunch instabilities are investigated. With a beam intensity of 1.0×10^{10} the longitudinal coupling impedance threshold, $|Z_{\|}(\omega)/n|$, is

found to be ~60 Ω at the injection momentum 12 GeV/c, and 12 Ω at the ejection momentum, 200 GeV/c. Coupled bunch instability growth rates are calculated for the λ/4 cavity higher order mode (HOM) spectrum.

27025 (SSCL-Preprint–391) **Emittance growth due to dipole ripple and sextupole.** Shih, H.J.; Ellison, J.A.; Syphers, M.J.; Newberger, B.S. Superconducting Super Collider Lab., Dallas, TX (United States). May 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930511–202: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93016181. Source: OSTI; NTIS; INIS; GPO Dep.

Ripple in the power supplies for storage ring magnets can have adverse effects on the circulating beams: orbit distortion and emittance growth from dipole ripple, tune modulation and dynamic aperture reduction from quadrupole ripple, etc. In this paper, we study the effects of ripple in the horizontal bending field of the SSC in the presence of nonlinearity, in particular, the growth in beam emittance.

27026 (SSCL-Preprint–399) **SSC High Energy Booster resonance corrector and dynamic tune scanning simulation.** Zhang, P.; Machida, S. Superconducting Super Collider Lab., Dallas, TX (United States). May 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930511–171: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93016123. Source: OSTI; NTIS; INIS; GPO Dep.

A resonance correction system for the High Energy Booster (HEB) of the Superconducting Super Collider (SSCL) was investigated by means of dynamic multiparticle tracking. In the simulation the operating tune is scanned as a function of time so that the bunch goes through a resonance. The performance of the half integer and third integer resonance correction system is demonstrated.

27027 (SSCL-Preprint–409) **Proton-proton scattering contribution to emittance growth.** Garavaglia, T. Superconducting Super Collider Lab., Dallas, TX (United States). May 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930511–186: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93016090. Source: OSTI; NTIS; INIS; GPO Dep.

Proton-proton scattering contributes to the emittance growth of the SSC. A formulation is given and used to estimate the mean scattering angle, which is used to determine the contribution to SSC emittance growth resulting from elastic pp scattering. The method is based upon Lorentz invariants, and it permits the determination of the cross-section for scattering in the center of mass (c.m.) system, as well as scattering from a fixed target (f.t.). Also an example is given for the case of electromagnetic pp scattering, which results from single virtual photon exchange.

27028 (SSCL-Preprint–411) **Second order chromaticity of the interaction regions in the collider.** Sen, T.; Syphers, M. Superconducting Super Collider Lab., Dallas, TX (United States). May 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930511–170: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93016109. Source: OSTI; NTIS; INIS; GPO Dep.

The collider in the SSC has large second order chromaticity (ξ_2) with the interaction regions (IRs) contributing substantially to it. We calculate the general expression for ξ_2 in a storage ring and find that it is driven by the first order chromatic beta wave. Specializing to the interaction regions, we show that ξ_2 is a minimum when the phase advance ($\Delta\mu_{IP-IP}$) between adjacent interaction points is an odd multiple of $\pi/2$ and both IRs are identical. In this case the first order chromatic beta wave is confined within the IRs. Conversely, ξ_2 is large either if $\Delta\mu_{IP-IP} = (2n + 1)\pi/2$ and the two IRs are very far from equality or if the two IRs are equal but $\Delta\mu_{IP-IP} = n\pi$.

27029 (SSCL-Preprint–412) **Effect of power supply ripple on emittance growth in the collider.** Sen, T.; Syphers, M. Superconducting Super Collider Lab., Dallas, TX (United States). May 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930511–182: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93016107. Source: OSTI; NTIS; INIS; GPO Dep.

Power supply ripple at frequencies of 720 Hz and its harmonies is expected to affect the motion of particles in the collider. These ripple frequencies are nearly resonant with the betatron frequencies. To estimate the tolerable ripple levels, we have tracked particles through the complete nonlinear lattice for 10^4 turns with ripple fed from 10 different power stations and including up to 7 different ripple frequencies. We presently estimate that relative ripple amplitudes must be below the 10^8 level for there to be no significant impact on the emittance over the short term.

27030 (UCRL-JC–110203) **Beam control in the ETA-II linear induction accelerator.** Chen, Yu-Jiuan. Lawrence Livermore National Lab., CA (United States). 21 Aug 1992. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9208109–86: 16. international LINAC conference, Ottawa (Canada), 23-28 Aug 1992). Order Number DE93013427. Source: OSTI; NTIS; GPO Dep.

Corkscrew beam motion is caused by chromatic aberration and misalignment of a focusing system. We have taken some measures to control the corkscrew motion on the ETA-11 induction accelerator. To minimize chromatic aberration, we have developed an energy compensation scheme which reduces energy sweep and differential phase advance within a beam pulse. To minimize the misalignment errors, we have developed a time-independent steering algorithm which minimizes the observed corkscrew amplitude averaged over the beam pulse. The steering algorithm can be used even if the monitor spacing is much greater than the system's cyclotron wavelength and the corkscrew motion caused by a given misaligned magnet is fully developed, i.e., the relative phase advance is greater than 27π.

4303 Auxiliaries and Components

Refer also to citation(s) 25727, 26279, 26856, 26877, 26971, 26983, 26996, 26998, 27000, 27021, 27023, 27026, 27029, 27153, 27161, 27163, 27166, 27168, 27169, 27174, 27185, 27186, 27189, 27199, 27206, 27207, 27208, 27209, 27212, 27745, 27874, 27875, 28042, 28055, 28060, 28064

27031 (ANL/ASD/CP–78167) **An I/O subnet for the APS control system: The BITBUS Universal Gateway.** Nawrocki, G.J.; Arnold, N.D.; Hoffberg, M.G.; Winans, J.R.; Benes, S.J. Argonne National Lab., IL (United States). [1993]. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-930511–132: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93015152. Source: OSTI; NTIS; GPO Dep.

The Advanced Photon Source (APS) control system is based an a distributed topology of microprocessor-based Input/Output Controllers (IOCs). Since the cost effectiveness of placing an IOC near every point where an interface to the control system is required may be prohibitive, I/O subnets implemented via message passing network protocols are utilized. For greatest flexibility, such a subnet must support connections to equipment via discrete I/O points, connections to standard interfaces such as GPIB and RS232, and be a practical network for custom-designed interfaces to intelligent equipment. This paper describes the BITBUS Universal Gateway (BUG), a device which supports the different interfaces mentioned above with a connection to a single BITBUS distributed subnet. The BUG utilizes an interchangeable set of circuit boards, which allow for a commonality among interface points, and the ability to use commercially available modules for I/O. This approach also circumvents several limitations of GPIB and RS232, which restrict their use in industrial electrically harsh environments, via an implementation of the BITBUS protocol over optical fibers.

27032 (ANL/ASD/CP–78290) **Abort interlock diagnostic for protection of APS vacuum chamber.** Decker, G. Argonne National Lab., IL (United States). [1993]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38.

(CONF-930511–137: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93015151. Source: OSTI; NTIS; INIS; GPO Dep.

The Advanced Photon Source (APS) vacuum system has been designed to be passively safe from bending magnet radiation heating at positron beam currents up to 30 mA. Above this value, certain components may be damaged from vertical beam missteering, although work is proceeding to raise the safe current threshold. Because of this, a system for preventing the misalignment of high power density beams is required. This report details a system for protection from dipole radiation only. Work on a system for ID radiation is continuing.

27033 (ANL/ASD/CP–78299) **Optimal magnet sorting procedure and application to the APS injector synchrotron.** Koul, R.K.; Lopez, F.; Mills, F.E. Argonne National Lab., IL (United States). [1993]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-930511–149: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93015166. Source: OSTI; NTIS; INIS; GPO Dep.

A magnet sorting procedure for accelerators is developed. It is implemented in two steps. The first step is completely analytical in character while the second step involves the comparison of computed values with the measured error values. The method has been implemented for sorting the Advanced Photon source (APS) injector synchrotron dipoles and quadrupoles with excellent results.

27034 (ANL/ASD/CP–78347) **A 2-Megawatt load for testing high voltage dc power supplies.** Horan, D.; Kustom, R.; Ferguson, M.; Primdahl, K. Argonne National Lab., IL (United States). [1993]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-930511–134: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93015141. Source: OSTI; NTIS; GPO Dep.

A high power water-cooled resistive load, capable of dissipating 2 Megawatts at 95 kilovolts is being designed and built. The load utilizes wirewound resistor elements suspended inside insulating tubing contained within a pressure vessel which is supplied a continuous flow of deionized water for coolant. A sub-system of the load is composed of non-inductive resistor elements in an oil tank. Power tests conducted on various resistor types indicate that dissipation levels as high as 22 times the rated dissipation in air can be achieved when the resistors are placed in a turbulent water flow of at least 15 gallons per minute. Using this data, the load w.as designed using 100 resistor elements in a series arrangement A single-wall 316 stainless steel pressure vessel with flanged torispherical heads is built to contain the resistor assembly and deionized water. The resistors are suspended within G-11 tubing which span the cylindrical length of the vessel. These tubes are supported by G-10 baffles which also increase convection from the tubes by promoting turbulence within the surrounding water.

27035 (ANL/ASD/CP–78370) **Status and design of the Advanced Photon Source control system.** McDowell, W.; Knott, M.; Lenkszus, F.; Kraimer, M.; Arnold, N.; Daly, R. Argonne National Lab., IL (United States). [1993]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-930511–146: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93015148. Source: OSTI; NTIS; INIS; GPO Dep.

This paper presents the current status of the Advanced Photon Source (APS) control system. It will discuss the design decisions which led us to use industrial standards and collaborations with other laboratories to develop the APS control system. The system uses high performance graphic workstations and the X-windows Graphical User Interface (GUI) at the operator interface level. It connects to VME/VXI-based microprocessors at the field level using TCP/IP protocols over high performance networks. This strategy assures the flexibility and expansibility of the control system. A defined interface between the system components will allow the system to evolve with the direct addition of future, improved equipment and new capabilities.

27036 (ANL/ASD/CP–78371) **Beam position monitor data acquisition for the Advanced Photon Source.** Lenkszus, F.R.; Kahana, E.; Votaw, A.J.; Decker, G.A.; Chung, Y.; Ciarlette, D.J.; Laird, R.J. Argonne National Lab., IL (United States). [1993]. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-930511–145: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93015149. Source: OSTI; NTIS; INIS; GPO Dep.

This paper describes the Beam Position Monitor (BPM) data acquisition scheme for the Advanced Photon Source (APS) storage ring. The storage ring contains 360 beam position monitors distributed around its 1104-meter circumference. The beam position monitor data acquisition system is capable of making turn-by-turn measurements of all BPMs simultaneously. It is VXI-based with each VXI crate containing the electronics for 9 BPMS. The VXI Local Bus is used to provide sustained data transfer rates of up to 13 mega-transfers per second to a scanner module. The system provides single-bunch tracking, bunch-to-bunch measurements, fast digital-averaged positions, beam position history buffering, and synchronized multi-turn measurements. Data is accessible to the control system VME crates via an MXI bus. Dedicated high-speed ports are provided to supply position data to beam orbit feedback systems.

27037 (ANL/PHY/CP–79517) **Experiments using the Argonne Fragment Mass Analyzer.** Davids, C.N. (Argonne National Lab., IL (United States)); Back, B.; Carpenter, M.P.; Henderson, D.J.; Henry, R.G.; Janssens, R.V.F.; Khoo, T.L.; Lauritsen, T.; Liang, Y.; Birdra, K.; Chung, W. Argonne National Lab., IL (United States). [1993]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-930169–2: 16. nuclear physics symposium, Oaxtepec (Mexico), 5-8 Jan 1993). Order Number DE93012902. Source: OSTI; NTIS; INIS; GPO Dep.

The Fragment Mass Analyzer (FMA) at the ATLAS accelerator has been operational for about one year. During that period a number of test runs and experiments have been carried out. The test runs have verified that the ion optics of the FMA are essentially as calculated. A brief facility description is followed by recent experimental results.

27038 (BNL–47596) **Axial variations in the magnetic field of superconducting dipoles.** Ghosh, A.K.; Robins, K.E.; Sampson, W.B. Brookhaven National Lab., Upton, NY (United States). [1992]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-920331–74: 4. international industrial symposium on the Super Collider, New Orleans, LA (United States), 4-6 Mar 1992). Order Number DE93014322. Source: OSTI; NTIS; INIS; GPO Dep.

Periodic variations in the field along the axis have been observed in a large number of superconducting dipoles. Both long and short versions of the SSC magnet have been examined as well as prototypes for the RHIC accelerator and coils from the CBA and ISABELLE projects. This field oscillation is present in all the components of the field. The period of the longitudinal pattern was found to match the conductor transposition length over a wide range of pitches. The amplitude of variation increases with time spent at high field and its decay has a complex time dependence. Unbalanced currents in the individual strands of the cable appear to be the cause of this effect and may also give rise to the unusually high sextupole drift observed near injection field in most dipoles.

27039 (BNL–48208) **On the high intensity aspects of AGS Booster proton operation.** Reece, R.K.; Ahrens, L.A.; Bleser, E.J.; Brennan, J.M.; Gardner, C.; Glenn, J.W.; Roser, T.; Shoji, Y.; van Asselt, W.; Weng, W.T. Brookhaven National Lab., Upton, NY (United States). [1993]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-930511–128: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014289. Source: OSTI; NTIS; INIS; GPO Dep.

Observations of high intensity effects on the proton performance of the AGS Booster are presented, including present operational limits and correction methods. The transverse emittances, optimum tune working points, damping of coherent transverse oscillations

and correction of stopband resonances through third-order are discussed in addition to the observed tune spread due to space charge forces. The initial longitudinal phase space distribution, capture and acceleration parameters and measurements are also given. Operational tools and strategies relevant to the high intensity setup are mentioned.

27040 (BNL–48236) **Ring diagnostics and consistency test of the model for the AGS Booster.** Luccio, A.; Auerbach, E.H. Brookhaven National Lab., Upton, NY (United States). [1993]. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-930511–126: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014297. Source: OSTI; NTIS; INIS; GPO Dep.

From a systematic analysis of readings of the beam position monitors in the AGS Booster ring, combined with the transfer matrices between a few locations in the ring, calculated with MAD, the consistency of the model of the lattice has been tested. This technique has enabled us to (1) detect errors in the machine that subsequent survey during shutdown has confirmed, and (2) to measure the actual circulating beam momentum offset The method has proved rather general and convenient for accelerator diagnostics as part of a model-based accelerator control system and extensions are suggested.

27041 (BNL–48260) **Results from the AGS Booster transverse damper.** Russo, D.; Brennan, M.; Meth, M.; Roser, T. Brookhaven National Lab., Upton, NY (United States). [1993]. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-930511–70: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014314. Source: OSTI; NTIS; INIS; GPO Dep.

To reach the design intensity of 1.5×10^{13} protons per pulse in the AGS Booster, transverse coupled bunch instabilities with an estimated growth rate of $1500s^{-1}$ have to be dampened. A prototype transverse damper has been tested successfully using a one turn digital delay and closed orbit suppression implemented in a programmable gate array. An updated damper, which includes an algorithm to optimize damping for a changing betatron rune, will also be presented.

27042 (BNL–48272) **Preliminary studies on a magneto-optical procedure for aligning RHIC magnets.** Goldman, M.A.; Sikora, R.E.; Shea, T.J. Brookhaven National Lab., Upton, NY (United States). [1993]. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-930511–167: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93015786. Source: OSTI; NTIS; INIS; GPO Dep.

Colloid dispersions of magnetite were used at SLAC and KEK to locate multipole magnet centers. We study the possible adaption of this method, to align RHIC magnets. A procedure for locating magnetic centers with respect to external fiducial markers, using electronic coordinate determination and digital TV image processing is described.

27043 (BNL–49073) **BNL volume H^- sources.** Alessi, J.G.; Prelec, K.; McCafferty, D. Brookhaven National Lab., Upton, NY (United States). [1992]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-921145–8: Production and neutralization of negative ions and beams, Upton, NY (United States), 9-13 Nov 1992). Order Number DE93015793. Source: OSTI; NTIS; INIS; GPO Dep.

An H^- current of up 30 mA has been extracted from a 1 cm^2 aperture in a 20 cm diameter volume source with a conical filter field. From a 9.7 cm diameter version of this source, an H^- current of up to 35 mA was extracted from a 0.5 cm^2 aperture.In both sources, the electron-to-H^- ratio is typically < 10, and often < 5.

27044 (DOE/FTR–93013017) **[Travel to Germany and Switzerland to discuss the progress and further development of the TESLA collaboration, and to present a paper and attend the European particle accelerator conference in Berlin, under the auspices of the Technische Hochschule Berlin]: Foreign trip report, March 17–April 5, 1992.** Colestock, P.L. Fermi National Accelerator Lab., Batavia, IL (United States). 1992. 40p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. Order Number DE93013017. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The trip consisted of three parts. The first was a meeting at the Deutsches Elektronen-Sychrotron (DESY) to discuss the progress and further development of the TESLA collaboration, a joint project with Fermilab, DESY, Cornell, among others, to develop a superconducting linac option for future collider applications. Milestones in the fabrication and testing of a prototype cavity module were adopted. The second part was attendance at the European Particle Accelerator Conference in Berlin, under the auspices of the Technische Hochschule Berlin. A paper was delivered there on recent developments in nonlinear phenomena studied in the Tevatron. The third part consisted of a brief visit to CERN, conferring with members of the rf group there on several topics of mutual interest, including impedance measurements, instability studies, stochastic cooling, and rf systems.

27045 (ENEA-RT-NUCL–91-19, pp. 13-22) **Radiation protection at Frascati neutron generator.** Lucci, F.; Sandri, S. ENEA, Frascati (Italy). Oct 1991. (CONF-911105–Exc.: Symposium on implications of the new ICRP recommendations on radiological protection practices, Salamanca (Spain), 26-29 Nov 1991; RT/NUCL–91-19). In *Contributions to international conference of implications of new ICRP recommendations on radiation protection practice and interventions.* 22p. Order Number DE93799291. Source: OSTI; NTIS (US Sales Only); INIS.

The paper presents the radiation protection proposal for the D-T Frascati Neutron Generator (FNG) of ENEA (Italian Agency for Energy, New Technologies and the Environment). The proposal was submitted to the Italian regulatory authority examination, approved and is now nearly complete. Planned and potential exposure situations are described and the consequent system of protection is compared with that described in the revised basic recommendations of the ICRP (International Commission on Radiation Protection). The technical characteristics of the FNG, the results of the calculations performed for shield design and activation evaluation are reported considering typical applications and material composition of the generator, together with a schematic design of the plant layout.

27046 (ETDE-IT–93-184) **Environmental conservation by radiation technology: New Italian multi-purpose demonstration centre.** Tata, A.; Manni, S. ENEA, Rome (Italy); Officine Galileo SpA, Florence (Italy). 1992. 10p. (CONF-920909–: 8. international meeting on radiation processing, Beijing (China), 14-19 Sep 1992). Order Number DE93799272. Source: OSTI; NTIS (US Sales Only); INIS.

The new Italian R&D/Demonstration Centre, named CE.S.T.I.A. (CEntro Sperimentazione Tecnologie di Irraggiamento per l'Ambiente, namely, Experimental Centre for Environmental Applications of Radiation Technology), presented in this paper should represent the largest project in the world for research on environmental applications of radiation technology. The Center will be located in the South of Italy and foresees, over an area of 35,000 square meters, four independent irradiation plants, each one with a dedicated electron beam machine. The foreseen EB-machines features allow a large operative flexibility; the first research cycle will regard five activity lines: hazardous wastes, waste water, flue gases, hospital wastes, clean technologies. The Centre technical and economic features are described, together with an analysis of realistic spreading perspectives of linear accelerator radiation technology on the Italian industrial wastes management market.

27047 (FNAL/C–92/94) **Friction and wear of radiation resistant composites, coatings and ceramics in vacuum and low temperature environment.** Lipski, A.; Ruschman, M. Fermi National Accelerator Lab., Batavia, IL (United States). Apr 1992. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. (CONF-9106431–1: CEC/ICMC conference, Huntsville, AL (United States), 11-14 Jun 1991). Order Number DE93014016. Source: OSTI; NTIS; INIS; GPO Dep.

Superconducting magnets used in accelerators such as the Superconducting Super Collider (SSC) are exposed to fast neutron

and gamma irradiation. Some of the components used in the SSC cryostat are fabricated from organic materials with low radiation resistance. The slide bearing material presently supporting the magnet assembly contains Teflon and must be replaced with a material of improved radiation resistance. A group of sliding materials, most of which have suitable radiation resistance, were tested under conditions of pressure, temperature, velocity, and vacuum typically encountered in normal cryostat operation. As this was a preliminary screening test, the samples were only cooled to liquid nitrogen temperature. The group of materials tested consists of composites, coated base metals, and ceramics. The criteria was to maintain a low coefficient of friction throughout the experiment in spite of changes in temperature and vacuum. Subsequent tests will expose finalist materials to fast neutron irradiation at liquid helium temperatures. This paper describes the experimental setup and presents data of the friction coefficient measurements taken for the various samples.

27048 (FNAL/C–92/98) **Alternate manufacturing processes and materials for the SSC dipole magnet coil end parts.** Lipski, A. (Fermi National Accelerator Lab., Batavia, IL (United States)); Bossert, R.; Brandt, J.; Hoffman, J.; Kobliska, G.; Zweibohmer, J.; Higinbotham, W.; Shields, R.; Sims, R. Fermi National Accelerator Lab., Batavia, IL (United States). Apr 1992. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. (SSCL-Preprint–97;CONF-920331–73: 4. international industrial symposium on the Super Collider, New Orleans, LA (United States), 4-6 Mar 1992). Order Number DE93014029. Source: OSTI; NTIS; INIS; GPO Dep.

Modern magnet designs such as the SSC dipole utilize smaller bore diameter and wider superconducting cable. Challenging winding techniques place greater emphasis on the role of the coil end parts. Their complex configuration is derived from their function of confining the conductors to a consistent given shape and location. Present end parts, made of G-10 composite, are manufactured utilizing complex and expensive 5-axis machining techniques. Several alternate manufacturing processes and materials described in this paper will result in a substantial cost reduction for mass producing the end parts. The alternate processes are divided into two major groups. The composite group consists of Resin Transfer Molding (RAM), Compound Transfer Mold (CAM), Injection Molded Composite (IMP) and Compression Molded Composite (CC). The base metal coated group consists of Chemical Vapor Deposition (CAD) dip coating and hard coatings/anodizing. The paper will provide an overview of the various processes and compare test performance and cost to that of the process currently used.

27049 (FNAL/C–93/075) **Study of stability of beam in the Fermilab main injector.** Mishra, C.S.; Harfoush, F. Fermi National Accelerator Lab., Batavia, IL (United States). Apr 1993. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. (CONF-921077–5: Stability of particle motion in storage rings, Upton, NY (United States), 18-24 Oct 1992). Order Number DE93014920. Source: OSTI; NTIS; INIS; GPO Dep.

The Fermilab Main Injector is a new 150 GeV proton synchrotron, designed to replace the Main Ring and improve the high energy physics potential of Fermilab. The status of the Fermilab accelerator complex upgrade will be discussed. Study of the stability of the beam in the Main injector will be discussed. Detuning and corrector scheme to improve the dynamic aperture of the Main Injector will be presented. Tune modulation caused by octupolar detuning will be discussed.

27050 (FNAL/C–93/108) **SSC 50 mm dipole magnet cryostat thermal measurement results.** Boroski, W.N.; Nicol, T.H.; Ruschman, M.K.; Schoo, C.J. Fermi National Accelerator Lab., Batavia, IL (United States). May 1993. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. (CONF-930537–55: 5. annual international industrial symposium on the Super Collider and exhibition, San Francisco, CA (United States), 6-8 May 1993). Order Number DE93015534. Source: OSTI; NTIS; INIS; GPO Dep.

A prototype Superconducting Super Collider (SSC) 50 mm dipole magnet cryostat, DCA323, was instrumented at Fermilab and delivered to the SSC Laboratory for installation into the accelerator systems string test facility. In series with other magnets, the instrumented cryostat will be used to quantify and verify cryostat thermal performance with respect to design requirements. Prior to leaving Fermilab, DCA323 was subjected to magnetic testing at the Magnet Test Facility (MTF). This presented an opportunity to obtain preliminary thermal performance data under simulated operating conditions. It should be noted that measurements of overall cryostat thermal performance were not possible during the MTF measurements as the magnet test stands are designed for magnetic rather than thermal testing. They are not designed to limit heat inleak to the ends of the cryostat, which has been shown to have a significant effect on overall measured thermal performance. Nonetheless, these measurements do offer insight into the performance of several of the cryostat components and sub-systems.

27051 (FNAL/C–93/110) **The design and performance of a high sensitivity loss monitor system for use in the Fermilab antiproton rings.** Halling, A.M.; Zagel, J.R.; Hahn, A. Fermi National Accelerator Lab., Batavia, IL (United States). May 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. (CONF-930511–142: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014921. Source: OSTI; NTIS; INIS; GPO Dep.

As part of a general laboratory cleanup of hazardous materials from the accelerator enclosures we have replaced the liquid scintillator based paint can type beam loss monitors with improved loss monitors based on plastic centiliter. This paper describes the design of these counters and their performance in the PBAR source.

27052 (FNAL/C–93/113) **Experience with the Source Evaluation Board method of procuring technical components for the Fermilab Main Injector.** Harding, D.J.; Collins, J.P.; Kobliska, G.R.; Chester, N.S.; Pewitt, E.G.; Fowler, W.B. Fermi National Accelerator Lab., Batavia, IL (United States). May 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. (CONF-930511–141: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014922. Source: OSTI; NTIS; GPO Dep.

Fermilab has adopted the Source Evaluation Board (SEB) method for procuring certain major technical components of the Fermilab Main Injector. The SEB procedure is designed to ensure the efficient and effective expenditure of Government funds at the same time that it optimizes the opportunity for attainment of project objectives. A qualitative trade-off is allowed between price and technical factors. The process involves a large amount of work and is only justified for a very limited number of procurements. Fermilab has gained experience with the SEB process in awarding subcontracts for major subassemblies of the Fermilab Main Injector dipoles.

27053 (FNAL/C–93/118) **Impedance budget and beam stability analysis of the Fermilab Main Injector.** Martens, M.A.; Ng, K.Y. Fermi National Accelerator Lab., Batavia, IL (United States). May 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. (CONF-930511–138: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014925. Source: OSTI; NTIS; INIS; GPO Dep.

The impedance budget of the Fermilab Main Injector (MI) is estimated, which includes the contributions from the resistive walls, bellows, rf cavities, steps, Lambertsons, etc. Beam stability during ramping and bunch coalescence is analyzed. The transverse resistive-wall coupled bunch growth is found to be somewhat worse than the situation in the Main Ring (MR).

27054 (IFVE-OKU–91-151) **The development of software application at the IHEP accelerator beam extraction control system.** Afonin, A.G.; Prisyazhnykh, S.G.; Sokolov, S.V.; Sokolova, O.A.; Sukhomlinov, V.F. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov (Russian Federation). Inst. Fiziki Vysokikh Ehnergij. 1991. [10p.] (In Russian). Order Number DE93629633. Source: OSTI; NTIS (US Sales Only); INIS.

The development of the software application for the minicomputer SM-4, that helps to decide the task of processing and

displaying informations at the IHEP accelerator beam extraction control system is considered. The software runs under OS RSX11M with using the FORTRAN and MACRO-11 programming languages. 7 refs.; 5 figs.

27055 (IFVE-OKU–91-157) **Pickup for the radial position of the beam center of gravity in the master oscillator system of the accelerator field frequency of the IHEP proton synchrotron.** Vazhenin, V.A.; Ignashin, N.A.; Lebedev, O.P. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov (Russian Federation). Inst. Fiziki Vysokikh Ehnergij. 1991. [7p.] (In Russian). Order Number DE93628260. Source: OSTI; NTIS (US Sales Only); INIS.

The presence of one radial pickup in the accelerator azimuth assigned for the master oscillator system of the accelerating field frequency makes the mean radius of particle accelerating dependent of the orbit harmonics orbits. This, in its turn, imposes streak requirements for the correction technique of the magnetic field harmonics. An additional radial pick up with a corresponding processing of the beam signal was introduced into beam feedback circuit. 1 ref.; 4 figs.

27056 (IFVE-OLU–92-115) **Automatic inspection of linear accelerator system operation.** Borovikov, A.A.; Khromova, G.N. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov (Russian Federation). Inst. Fiziki Vysokikh Ehnergij. 1992. [9p.] (In Russian). Order Number DE93628255. Source: OSTI; NTIS (US Sales Only); INIS.

In this paper there is suggested the procedure for the automatic control of the linear accelerator systems operation situation. The simple data model for the estimate of time variation linac systems parameters is used to represent an operating situation with the formalistic data. The knowledge-based algorithm is proposed to automatic discover time points and signs of arising infringements. 4 refs.; 3 figs.

27057 (IFVE-ONF–92-106) **Magnetized muon filter for beam-dump experiments.** Ammosov, V.V.; Garkusha, V.I.; Zaruchejskij, V.G.; Kartashev, V.P.; Kotov, V.I.; Mokhov, N.V.; Novoskol'tsev, F.N.; Uzunyan, A.V. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov (Russian Federation). Inst. Fiziki Vysokikh Ehnergij. 1992. [12p.] (In Russian). Order Number DE93628261. Source: OSTI; NTIS (US Sales Only); INIS.

The design of magnetized muon filter was elaborated for τ-neutrino research in beam-dump experiment. The parameters of muon fiter were optimized for 3000 GeV initial proton beam and 2 meters detector radius installed at the distance 300 of meters from the target. The main sources determining muon background on the detector were analyzed. It is shown that the filter provides the muon flux on the detector less than 10^{-11} muonxproton^{-1}. 11 refs.; 10 figs.

27058 (IFVE-ORI–91-160) **Radiation situation in the region of block 27 of the U-70 main ring.** Borodin, V.E.; Gurchin, V.Yu. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov (Russian Federation). Inst. Fiziki Vysokikh Ehnergij. 1991. [16p.] (In Russian). Order Number DE93629644. Source: OSTI; NTIS (US Sales Only); INIS.

This note describes results of stadying radiation situation in region of IHEP proton synchrotron where materials are irradiated for the study of radiation damage. 7 refs.; 28 figs.; 2 tabs.

27059 (IFVE-ORI–92-64) **The hadron flux inside of experimental hall-2 of UNK hadron area.** Bajshev, I.S.; Bityukov, S.I.; Kryuchkov, V.P.; Mokhov, N.V.; Uzunyan, A.V.; Chepegin, V.N. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov (Russian Federation). Inst. Fiziki Vysokikh Ehnergij. 1992. [8p.] (In Russian). Order Number DE93628262. Source: OSTI; NTIS (US Sales Only); INIS.

The results on calculating of radiation hadron flux distributions inside and around of UNK experimental hall-2 are presented. The radiation source is the inelastic interactions of hadron beam with the elements of experimental equipment. Ways for decreasing scattered radiation dose rate are given. 6 refs.; 10 figs.

27060 (INS–956) **A new cooling and focusing device for ion guide.** Xu Hongjie; Wada, Michiharu; Tanaka, Jinichi; Kawakami, Hirokane; Katayama, Ichiro; Ohtani, Shunsuke. Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study. Dec 1992. 22p. Order Number DE93508254. Source: OSTI; NTIS; INIS.

A highly efficient focusing device using RF multipole field 'sextupole-ion-beam-guide (SPIG)' has been developed for the ion guide isotope separator on-line (IGISOL). The SPIG, placed after the nozzle, consists of the six circular rods uniformly distributed on a circle in the plane perpendicular to the symmetry axis. Under the combined action of the sextupole RF electric field produced by the rods and helium gas flow, a good focusing and cooling of ions from the Ion Guide with highly efficient transmission are achieved in the SPIG. The experimental results using a discharge ion source show that almost nearly 90 % of the ions out of the nozzle can be transported through the SPIG, and the width of the kinetic energy distribution after the SPIG is about 0.8 eV (FWHM). These experimental results coincide well with the Monte-Carlo simulation results and the simulation also predicts the size of the spatial distribution in the plane perpendicular to the symmetry axis is smaller than 1 mm$^{\phi}$ at the end of the SPIG. (author).

27061 (IYaF–91-113) **The VLEPP final focus system.** Seryj, A.A. AN SSSR, Novosibirsk (Russian Federation). Inst. Yadernoj Fiziki. 1991. [33p.] (In Russian). Order Number DE93629645. Source: OSTI; NTIS (US Sales Only); INIS.

The results of the VLEPP final focus system investigation are presented. The common limitations for such systems are drown. Problems connected with background in the interaction region. IP design, optics, tolerances are discussed. The test low aperture final quadrupole with high gradient, the method and the results of the field distribution measurements for such a quadrupole are also presented. 24 refs.; 10 figs.; 1 tab.

27062 (IYaF–92-76) **Optimal choice of a target for producing e^+e^- polarized beams for a linear collider.** Bukin, A.D.; Mikhajlichenko, A.A. AN SSSR, Novosibirsk (Russian Federation). Inst. Yadernoj Fiziki. 1992. [36p.] (In Russian). Order Number DE93629646. Source: OSTI; NTIS (US Sales Only); INIS.

For polarized particles generation with the help of radiation from helical wiggler, applicable in linear collider, new calculations are represented. This calculations are made with the codes UNIMOD2, CONVER and OBRA, concerning the choice of optimal thickness and form of the target for different energy of initial beam. Optimized target gives maximal yield of polarized particles. Heating conditions of the target are described also. Estimations were made also how to test this method of particle production at SLAC Linac. 18 refs.; 16 figs.; 13 tabs.

27063 (JAERI-M–93-047) **JAERI TIARA annual report vol. 1 (1992): April 1991 - March 1992.** Ishigaki, Isao (Japan Atomic Energy Research Inst., Takasaki, Gunma (Japan). Takasaki Radiation Chemistry Research Establ); Nashiyama, Isamu; Naramoto, Hiroshi; Omichi, Hideki; Tanaka, Ryuichi; Watanabe, Hiromasa; Watanabe, Hiroshi (eds.). Japan Atomic Energy Research Inst., Tokyo (Japan). Mar 1993. 208p. Order Number DE93508317. Source: OSTI; NTIS; INIS.

This annual report describes research activities which have been performed with the JAERI TIARA (Takasaki Ion Accelerators for Advanced Radiation Application) facilities from April 1, 1991 to March 31, 1992, and also gives an outline of the ion accelerators and surrounding apparatus which have been constructed and prepared for various experiments. As well as an outline of the characteristics of AVF cyclotron, 3 MV tandem electrostatic accelerator and other ones, included are 25 summary reports on preparation of experimental apparatus and on the preliminary results of experimental studies using the 3 MV tandem accelerator in the different research fields of beam technology, materials for space environment and nuclear fusion reactor, organic and inorganic functional materials, biology, medicine, radiation chemistry, radioisotope production and nuclear chemistry. Lists of publication, staff of TIARA and cooperated researchers are also given. (author).

27064 (KCP–613-5221) **High density harp for SSCL linac.** Fritsche, C.T. (Allied-Signal, Inc., Kansas City, MO (United States). Bendix Kansas City Div.); Krogh, M.L.; Crist, C.E. Allied-Signal,

Inc., Kansas City, MO (United States). Bendix Kansas City Div. May 1993. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00613. (CONF-930511–7: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93013434. Source: OSTI; NTIS; INIS; GPO Dep.

AlliedSignal Inc., Kansas City Division, and the Superconducting Super Collider Laboratory (SSCL) are collaboratively developing a high density harp for the SSCL linac. This harp is designed using hybrid microcircuit (HMC) technology to obtain a higher wire density than previously available. The developed harp contains one hundred twenty-eight 33-micron-diameter carbon wires on 0.38-mm centers. The harp features an onboard broken wire detection circuit. Carbon wire preparation and attachment processes were developed. High density surface mount connectors were located. The status of high density harp development will be presented along with planned future activities.

27065 (KEK–92-21) **Collective issues related to B-factories.** Pestrikov, D.V. National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Feb 1993. 41p. Order Number DE93508336. Source: OSTI; NTIS; INIS.

This report reviews the limitations on the performance of the planned B- and Φ-factories due to the collective interactions of stored bunches. Together with the traditional revision of the limitations due to the single- and multi-bunch interaction with surrounding electrodes, we briefly discuss in this report the limitations on the performance due to collective beam-beam instabilities of colliding beams and instabilities due to the collective interaction of beams with the ions. (author).

27066 (LA-UR–93-1737) **Injector design for high-current CW proton linacs.** Stevens, R.R. Jr.; Sherman, J.D.; Schneider, J.D. Los Alamos National Lab., NM (United States). [1993]. 4p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930511–101: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014575. Source: OSTI; NTIS; INIS; GPO Dep.

We present an injector design for high-power cw proton linacs with particular emphasis on intense neutron-spallation sources. Long-term operational reliability and availability dominate over specific beam parameters for these accelerators. We discuss technical requirements for the ion source and low-energy beam transport line and compare different options. A prototype design for a 75-kV, 110-mA cw proton injector is presented.

27067 (LA-UR–93-1743) **Initial operation of the CW 8X H^- ion source discharge.** Smith, H.V. Jr.; Allison, P.; Geisik, C.; Schmitt, D.R.; Schneider, J.D.; Stelzer, J.E. Los Alamos National Lab., NM (United States). [1993]. 4p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930511–81: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014574. Source: OSTI; NTIS; INIS; GPO Dep.

A pulsed 8X source was built and the H^- beam current, emittance, and power efficiency were measured. These results were promising, so a cooled, dc version designed for operation at arc power levels up to 30 kW was built. Testing of the CW 8X source discharge is underway. The design dc power loading on the cathode surface is 900 W/cm^2, considerably higher than achieved in any pervious Penning surface-plasma source (SPS). Thus, the electrode surfaces are cooled with pressurized, hot water. We describe the source and present the initial operating experience and arc test results.

27068 (LA-UR–93-1778) **Monitoring production target thickness.** Oothoudt, M.A. Los Alamos National Lab., NM (United States). [1993]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930511–103: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014568. Source: OSTI; NTIS; INIS; GPO Dep.

Pion and muon production targets at the Clinton P. Anderson Meson Physics Facility consist of rotating graphite wheels. The previous target thickness monitoring Procedure scanned the target across a reduced intensity beam to determine beam center. The fractional loss in current across the centered target gave a measure of target thickness. This procedure, however, required interruption of beam delivery to experiments and frequently indicated a different fractional loss than at normal beam currents. The new monitoring Procedure compares integrated ups and downs toroid current monitor readings. The current monitors are read once per minute and the integral of readings are logged once per eight-hour shift. Changes in the upstream to downstream fractional difference provide a nonintrusive continuous measurement of target thickness under nominal operational conditions. Target scans are now done only when new targets are installed or when unexplained changes in the current monitor data are observed.

27069 (LA-UR–93-1782) **Comprehensive beam jitter study for the commissioning of the intermediate matching section and drift tube linac at ground test accelerator.** Barr, D.S.; Gilpatrick, J.D. Los Alamos National Lab., NM (United States). [1993]. 4p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930511–102: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014567. Source: OSTI; NTIS; INIS; GPO Dep.

An experiment on the Ground Test Accelerator (GTA) for the Neutral Particle Beam (NPB) at Los Alamos commissioned the intermediate matching section (IMS) and a single 3.2-MeV drift tube linac (DTL). A diagnostic platform or D-plate was used at the output of the DTL in order to measure various beam parameters. The D-plate and other diagnostic devices located in the IMS, provided measurement of the horizontal and vertical beam position, current, energy, and output phase. These instruments were installed to perform a complete beam jitter analysis based on the current beamline configuration to better understand the causes of any jitter sources as well as to prepare for the initial design of future feedback control systems. The study explored all types of jitter for various beamline configurations. Both interpulse jitter (jitter from pulse to pulse) and intrapulse jitter (jitter within each macropulse) were investigated. Spectral and statistical time analyses were used. Spectral analysis was employed to gain an understanding of the spectral contributions of various jitter sources to determine the degree of correction possible. Statistical time analysis gave a good overall representation of the jitter magnitude and allowed easy comparison of jitter for different beamline configurations, as well as an easy method for determining consistent problems.

27070 (LA-UR–93-1821) **Pulsed taut-wire measurement of the magnetic alignment of the ITS induction cells.** Melton, J.G.; Burns, M.J.; Honaberger, D.J. Los Alamos National Lab., NM (United States). [1993]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930511–105: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014555. Source: OSTI; NTIS; INIS; GPO Dep.

The mechanical and magnetic alignment of the first eight induction-cell, solenoid magnets of the Integrated Test Stand (ITS) for the Dual-Axis Radiographic Hydrodynamic Test (DARHT) facility were measured by observing the deflection of a fine, taut wire carrying a pulsed current. To achieve the required alignment (less than 0.25 mm offset and less than 5 mrad tilt), the magnet design uses quadrufilar windings and iron field-smoothing rings. After detailed measurements of each solenoid magnet, the cells are assembled and then mechanically aligned using a laser and an alignment target moved along the cell centerline. After the cells are in final position, the pulsed wire method is used to verify the magnetic alignment. The measurements show an average offset of the magnetic axes from the mechanical axis of 0. 15 mm, with a maximum offset of 0.3 mm. The average tilt of the magnetic axis was 0.7 mrad with a maximum tilt of 1.4 mrad. Tilts are corrected to less than 0.3 mrad, using dipole trim magnets assembled into each cell. Correction is limited noise.

27071 (LA-UR–93-1827) **Prototype flying-wire beam-profile monitor.** Barlow, D.B.; Fortgang, C.M.; Gilpatrick, J.D.; Meyer, R.E.; Rendon, A.M.; Warren, D.S.; Wilke, M.D. Los Alamos National Lab., NM (United States). [1993]. 4p. Sponsored by Department of Defense, Washington, DC (United States). DOE

Contract W-7405-ENG-36. (CONF-930511–98: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014651. Source: OSTI; NTIS; INIS; GPO Dep.

A prototype flying-wire beam-profile monitor has been designed, fabricated and tested to measure profiles of highcurrent high-duty electron beams. The device measures the beam's horizontal and vertical profile with a pair of thin carbon filaments mounted on a wheel. The beam that intercepts the filaments, or wires, produces electrons by secondary emission in proportion to the incident beam current. The secondary electron signal is detected either by measuring the charge depletion current on the wires or by measuring the current collected on a pair of positively biased charge collectors. A servo motor is used to accelerate the wheel from rest to a speed of 25 RPS in less than half a revolution passing the wires through the path of the beam at a speed of ~10 m/s. The wheel is then decelerated back to rest before completing one full revolution. The precise timing requirements of this application lead to the development of an indexer capable of controlling the servo motor position with less than 20 μs of timing jitter.

27072 (LA-UR–93-1828) **Commissioning of the first drift tube linac module in the Ground Test Accelerator.** Johnson, K.F.; Sander, O.R.; Atkins, W.H.; Bolme, G.O.; Bowling, S.; Cole, R.; Connolly, R.; Denney, P.; Erickson, J.; Gilpatrick, J.D.; Ingalls, W.B.; Kersteins, D.; Kraus, R.; Lysenko, W.P.; McMurry, D.; Mottershead, C.T.; Power, J.; Rose, C.; Rusthoi, DLos Alamos National Lab., NM (United States). [1993]. 4p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930511–106: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014551. Source: OSTI; NTIS; INIS; GPO Dep.

The Ground Test Accelerator (GTA) has the objective of verifying much of the technology required for producing high-brightness, high-current H^- beams. GTA commissioning is staged to verify the beam-dynamics design of each major accelerator component as it is brought on-line. The major components are the 35-keV H^- injector, the 2.5-MeV radio-frequency quadrupole (RFQ), the intertank matching section (IMS), the 3.2 MeV first $2\beta\lambda$ drift tube linac (DTL-1) module, and the 24-MeV GTA with 10 DTL modules. Results from the DTL-1 beam experiments will be presented.

27073 (LA-UR–93-1833) **High bandwidth beam current monitor.** Baltrusaitis, R.M. (Los Alamos National Lab., NM (United States)); Ekdahl, C.A.; Cooper, R.G.; Peterson, E.; Warn, C.E. Los Alamos National Lab., NM (United States). [1993]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36 ;AC08-88NV10617. (CONF-930511–96: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014737. Source: OSTI; NTIS; GPO Dep.

A stripline directional coupler beam current monitor capable of measuring the time structure of a 30-ps electron beam bunch has been developed. The time response performance of the monitor compares very well with Cherenkov light produced in quartz by the electron beam. The four-pickup monitor is now used on a routine basis for measuring the beam duration, tuning for optimized beam bunching, and centering the bunch in the beam pipe.

27074 (LA-UR–93-1847) **The Los Alamos VXI-based modular RF control system.** Jachim, S.P.; Ziomek, C.; Natter, E.F.; Regan, A.H.; Hill, J.; Eaton, L.; Gutscher, W.D.; Curtin, M.; Denney, P.; Hansberry, E.; Brooks, T. Los Alamos National Lab., NM (United States). [1993]. 6p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930511–97: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014548. Source: OSTI; NTIS; INIS; GPO Dep.

This paper describes the design and implementation of the Los Alamos modular RF control system, which provides high-performance feedback and/or feedforward control of RF accelerator cavities. This is a flexible, modular control system which has been realized in the industry-standard VXI cardmodular format. A wide spectrum of system functionality can be accommodated simply by incorporating only those modules and features required for a particular application. The fundamental principles of the design approach are discussed. Details of the VXI implementation are given, including the system architecture and interfaces, performance capabilities, and available features.

27075 (LA-UR–93-1848) **The effects of temperature and rf power level on the tuning of the water-cooled SSC Low-Energy Booster cavity.** Friedrichs, C. (Los Alamos National Lab., NM (United States)); Hulsey, G. Los Alamos National Lab., NM (United States). [1993]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930511–107: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014547. Source: OSTI; NTIS; INIS; GPO Dep.

The SSC Low-Energy Booster (LEB) cavity must rapidly tune from 47.52 to 59.78 MHz. The cavity tuner will use transversely biased ferrite control of the cavity resonance. The thermal expansion of a cavity's materials affects its resonance. There are two other known temperature mechanisms that affect resonance in the water-cooled LEB cavity. The saturation magnetization of the ferrite is a function of temperature, and since the ferrite permeability is dependent on the saturation magnetization, the ferrite permeability is also temperature dependent. The ferrite cooling water is present in the tuner rf field, hence the water permittivity, which is very temperature dependent, also affects cavity resonance. While taking data on the SSC Test Cavity to quantify the effect of temperature on the resonance, we observed that the rf power level also perturbed the resonance. It was readily apparent from the data that the power level affected the resonance much more strongly at low values of control bias than at high values. In fact, when we calculate an apparent modified control-bias H field that produces the observed resonance shift, we noticed an almost perfect, though non-linear, correlation between the ratio of H_{rf} to H_{bias} and the apparent modified bias field, H_{app}. This paper will present a set of equations to predict the resonance shifts produced by changes in temperature and rf power level. It will also present the techniques, both theoretical and empirical, by which these equations are derived. Finally, some of the methods for dealing with these resonance shifts will be discussed.

27076 (LA-UR–93-1853) **Control system architecture: The standard and non-standard models.** Thuot, M.E.; Dalesio, L.R. Los Alamos National Lab., NM (United States). [1993]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930511–115: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014546. Source: OSTI; NTIS; INIS; GPO Dep.

Control system architecture development has followed the advances in computer technology through mainframes to minicomputers to micros and workstations. This technology advance and increasingly challenging accelerator data acquisition and automation requirements have driven control system architecture development. In summarizing the progress of control system architecture at the last International Conference on Accelerator and Large Experimental Physics Control Systems (ICALEPCS) B. Kuiper asserted that the system architecture issue was resolved and presented a "standard model". The "standard model" consists of a local area network (Ethernet or FDDI) providing communication between front end microcomputers, connected to the accelerator, and workstations, providing the operator interface and computational support. Although this model represents many present designs, there are exceptions including reflected memory and hierarchical architectures driven by requirements for widely dispersed, large channel count or tightly coupled systems. This paper describes the performance characteristics and features of the "standard model" to determine if the requirements of "non-standard" architectures can be met. Several possible extensions to the "standard model" are suggested including software as well as the hardware architectural feature.

27077 (LA-UR–93-1867) **Stripper-foil scan studies of the first-turn beam loss mechanism in the LAMPF proton storage ring (PSR).** Hutson, R.: Fitzgerald, D.; Frankle, S.; Macek, R.; Plum, M.; Wilkinson, C. Los Alamos National Lab., NM (United States). [1993]. 4p. Sponsored by USDOE, Washington, DC

(United States). DOE Contract W-7405-ENG-36. (CONF-930511–46: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014478. Source: OSTI; NTIS; INIS; GPO Dep.

First-turn beam losses in the LAMPF Proton Storage Ring were measured as a function of the left-right position of the carbon foil used to strip neutral hydrogen atoms to H^+ for proton injection into the PSR. Two foil thicknesses, 200 and 300 $\mu g/cm^2$, were tested. Results indicated that first-turn loss is caused predominately by magnetic field stripping of a small fraction of the H_0 atoms that pass through the stripper foil without being stripped to protons, and the results were not consistent with a mechanism involving protons originating from atoms in the halo of the neutral beam incident on the stripper foil.

27078 (LA-UR–93-1871) **Results of adaptive feedforward on GTA.** Ziomek, C.D.; Denney, P.M.; Regan, A.H.; Lynch, M.T.; Jachim, S.P.; Eaton, L.E.; Natter, E.F. Los Alamos National Lab., NM (United States). [1993]. 4p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930511–93: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014475. Source: OSTI; NTIS; GPO Dep.

This paper presents the results of the adaptive feedforward system in use on the Ground Test Accelerator (GTA). The adaptive feedforward system was shown to correct repetitive, high-frequency errors in the amplitude and phase of the RF field of the pulsed accelerator. The adaptive feedforward system was designed as an augmentation to the RF field feedback control system and was able to extend the closed-loop bandwidth and disturbance rejection by a factor of ten. Within a second implementation, the adaptive feedforward hardware was implemented in place of the feedback control system and was shown to negate both beam transients and phase droop in the klystron amplifier.

27079 (LA-UR–93-1880) **Measuring emittance using beam position monitors.** Russell, S.; Carlsten, B. Los Alamos National Lab., NM (United States). [1993]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930511–48: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014470. Source: OSTI; NTIS; INIS; GPO Dep.

The Los Alamos Advanced Free Electron Laser uses a high charge (greater than InC), low emittance (normalized rams emittance less than 5π mm mrad) photoinjector driven accelerator. The high brightness achieved is due, in large part, to the rapid acceleration of the electrons to relativistic velocities. As a result, the beam does not have time to thermalize its distribution and its universe profile is, in general, non-Gaussian. This, coupled with the very high brightness, makes it difficult to measure the transverse emittance. Techniques used must be able to withstand the rigors of very intense electron beams, and not be reliant on Gaussian assumptions. Beam position monitors are ideal for this. They are not susceptible to beam damage, and it has been shown previously that they can be used to measure the transverse emittance of a beam with a Gaussian profile. However, this Gaussian restriction is not necessary and, in fact, a transverse emittance measurement using beam position monitors is independent of the beam's distribution.

27080 (LA-UR–93-1881) **Measured performance of the GTA rf systems.** Denney, P.M.; Jachim, S.P. Los Alamos National Lab., NM (United States). [1993]. 4p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930511–100: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014469. Source: OSTI; NTIS; INIS; GPO Dep.

This paper describes the performance of the RF systems on the Ground Test Accelerator (GTA). The RF system architecture is briefly described. Among the RF performance results presented are RF field flatness and stability, amplitude and phase control resolution, and control system bandwidth and stability. The rejection by the RF systems of beam-induced disturbances, such as transients and noise, are analyzed. The observed responses are also compared to computer-based simulations of the RF systems for validation.

27081 (LA-UR–93-1893) **Superconducting multicell cavity development program at Los Alamos.** Rusnak, B. (Los Alamos National Lab., NM (United States)); Spalek, G.: Gray, E.; DiMarco, J.N.; DeHaven, R.; Novak, J.; Walstrom, P.; Zumbro, J.; Thiessen, H.A.; Langenbrunner, J. Los Alamos National Lab., NM (United States). [1993]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930511–43: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014467. Source: OSTI; NTIS; INIS; GPO Dep.

The superconducting rf (SCRF) cavity Development Program at Los Alamos has designed, fabricated, and tested single-cell niobium cavities at 3-GHz and 805-MHz. This work is being done in preparation for procuring and testing a multicell niobium cavity. The multicell cavity is designed to accelerate protons at $\beta = 0.9$; initial tests will be without beam. Progammmatic changes have required us to modify our plans to install a 6800-liter helium cryostat and a 12.8-g/s helium pump. We will use an installed cryostat to test the multicell cavity. Also, the cavity will be modified from a seven-cell to a four-cell structure to match the dimensions of the installed cryostat. Previous reports concentrated on 3-GHz results. In this paper, some of the latest results of the 805-MHz cavity tests are presented. Modifications to allow high pulsed power (HPP) testing on 805-MHz single- and four-cell cavities are proceeding. Glow discharge cleaning of an 805-MHz niobium cavity resulted in a decrease in cavity performance. The cavity was restored to previous performance levels with buffered chemical polishing (bcp). Initial results with high-pressure water cleaning show the process is useful in restoring cavity performance.

27082 (LA-UR–93-1910) **Application of precision mechanical engineering techniques to the design of a moderate energy beam transport for the FAA explosive detection system.** Lujan, R.; Christensen, K. Los Alamos National Lab., NM (United States). [1993]. 4p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930511–99: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014461. Source: OSTI; NTIS; INIS; GPO Dep.

This paper discusses the application of precision mounting and alignment techniques to a moderate energy beam transport system (MEBT) used on the exit of a 1.75 MeV RFQ. While frequently found in optical systems, techniques-such-as kinematic mounting, and degree-of-freedom decoupling, are not as widely used for accelerator components. The MEBT consist of one permanent magnet quadrupole, four electro magnet quadrupole, and one debuncher cavity. Included in the paper are discussions of design and fabrication considerations as well as, installation, alignment and operations experience during the successful implementation on a working accelerator.

27083 (LA-UR–93-1912) **Response of air-filled ion chambers to high-intensity radiation pulses.** Plum, M.; Brown, D. Los Alamos National Lab., NM (United States). [1993]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930511–51: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014460. Source: OSTI; NTIS; INIS; GPO Dep.

Ion chambers are one of the most popular types of detectors used for beam loss-monitor systems. To provide a foundation for the development of future loss-monitor systems, and to fully characterize the ion chambers in use at LAMPF, we have studied the response of air-filled cylindrical ion chambers to high-intensity, short-duration radiation pulses. The most intense pulses were about 180 rad in 250 ns (the equivalent steady-state dose rate was about 700 Mrad/h). We filled our chambers with nitrogen gas at 760 Torr and air at 600 Torr. The ion chambers were driven into extreme nonlinear response. We hope these data will be used to design loss-monitor systems based on air-filled ion chambers, thus eliminating the need for gas-flow systems and/or airtight ion chambers.

27084 (LA-UR–93-1924) **Volume H^- Ion source development at LAMPF.** York, R.L.; Tupa, D.; Swenson, D.R.; Damjanovich, R. Los Alamos National Lab., NM (United States). [1993]. 4p. Sponsored by USDOE, Washington, DC (United

States). DOE Contract W-7405-ENG-36. (CONF-930511–92: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014455. Source: OSTI; NTIS; INIS; GPO Dep.

One method of increasing the intensity of the LAMPF proton Storage Ring is to use a brighter H^- ion source. To develop such a source, the performance of the small LBL dipole filter and the BNL toroidal filter volume H^- sources are being investigated. Results of testing a new high-duty-factor design of the BNL toroidal filter volume source are discussed. Results of experiments to reduce the electron to H^- ratio and modulate the beam intensity in the small LBL source are presented.

27085 (LA-UR–93-1928) **Cryogenic cooling system for the ground test accelerator.** Edeskuty, F.J. (Los Alamos National Lab., NM (United States)); Stewart, W.F.; Moeller, J.; Durham, F.; Spulgis, I. Los Alamos National Lab., NM (United States). [1993]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930703–1: International cryogenic engineering conference and international cryogenic materials conference, Albuquerque, NM (United States), 12-16 Jul 1993). Order Number DE93014393. Source: OSTI; NTIS; GPO Dep.

A cryogenic cooling system has been designed, built and tested for the Ground Test Accelerator (GTA) at the Los Alamos National Laboratory. Major components of the GTA require cooling to less than 50 K to reduce rf-heating and to increase thermal stability. The cooling system is capable of cooling (at an acceptable rate for thermal stresses) the cryogenically cooled components and then maintaining them at their operating temperature during accelerator testing for all modes and power levels of operation. The accelerator components are cooled by circulating cold, dense helium gas (about 21 K and 2.1 MPa) through the components. The circulating helium is refrigerated in a heat exchanger that uses boiling liquid hydrogen as a source of refrigeration. The cryogenic cooling system consists of the following major components: a liquid hydrogen (LH_2) storage Dewar with a transfer line to an LH_2 run tank containing an LH_2/gaseous helium (GHe) heat exchanger, circulation lines, and a circulation pump. The system, sized to cool a load of approximately 40 kW at temperatures as low as 20 K, is operational, but has not yet been operated in conjunction with the accelerator.

27086 (LA-UR–93-1955) **Integrating Log-Ratio position processing for the Los Alamos Proton Storage Ring extraction line.** Hardek, T.W. (Los Alamos National Lab., NM (United States)); Band, A. Los Alamos National Lab., NM (United States). [1993]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930511–37: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014356. Source: OSTI; NTIS; INIS; GPO Dep.

The Los Alamos Proton Storage Ring (PSR) compressor ring intended to accept 1-msec-long p macropulses from the LAMPF linear accelerator and compress these pulses to 250 nsec in length. Beam position monitor sensors of the terminated strip-line design centered at 200 nsec are provided in the transport line from LAMPF, the PSR injection line, the PSR ring, and the extracted beam line. Strip-line sensors used in conjunction with phase processing are a good match for linac transport lines and PSR injection lines where there exists a strong 200-MHz frequency component but lead to difficulties in the ring and extracted beam line where this component tends to wash out. This paper describes the development of Integrating Log-Ratio processing techniques, which utilize the original strip line sensors to achieve a major improvement in position monitoring for the extracted beam line. The design concepts are discussed and the present hardware is described in detail. Operational difficulties encountered during the development process are discussed and actual beam-related results are provided.

27087 (LA-UR–93-2038) **Measurement of H zero excited states produced by foil stripping of 800-MeV H^- ions.** Donahue, J.B. (Los Alamos National Lab., NM (United States)); Clark, D.A.; Cohen, S.; Fitzgerald, D.; Frankle, S.C.; Huston, R.L.; Macek, R.; MacKerrow, E.; van Dyck, O.; Wilkinson, C.; Byrant, H.; Gulley, M.; Halka, M.; Keating, P.; Miller, W. Los Alamos National Lab., NM (United States). [1993]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930511–45: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014391. Source: OSTI; NTIS; INIS; GPO Dep.

Foil stripping of H^- directly to H^+ is being considered for proton injection in the next generation of high-current proton storage rings. This technique can result in significant losses because excited states of HO, which are also produced in the foil, are field stripped in the downstream bending magnets. Without due care in the injection system design, many of the resulting protons will be outside the acceptance of the storage ring and will be quickly lost. We measured the production of such H^0 excited states at the LAMPF High Resolution Atomic Beam Facility. An 800-MeV H^- beam was passed through carbon foils of thicknesses 70, 100, 200, and 300 $\mu g/cm^2$, and the excited states were analyzed by a special magnet downstream of the foil. The magnet had a linear field gradient so that the trajectories of the outgoing protons could be used to reconstruct the field values at which the various H^0 stripped. We found that about 1% of the H^0 emerge in excited states which can be stripped to protons by ring-bending magnets.

27088 (LBL–34052) **Magnetic measurements of the 5 meter QC series quadrupoles at Lawrence Berkeley Laboratory.** Barale, P.; Benjegerdes, B.; Caspi, S.; Green, M.I.; Lietzke, A.; Schermer, R.; Taylor, C.; Van Dyke, D. Lawrence Berkeley Lab., CA (United States). May 1993. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (MT–470;SC-MAG–409;CONF-930537–52: 5. annual international industrial symposium on the Super Collider and exhibition, San Francisco, CA (United States), 6-8 May 1993). Order Number DE93015175. Source: OSTI; NTIS; GPO Dep.

From May 1991 to September 1992, magnetic measurements were performed on six 5 meter prototype SSC quadrupoles designed and built at Lawrence Berkeley Laboratory (LBL). In addition, one of the quadrupoles was disassembled, reassembled and remeasured. The purpose of this paper is to review the magnetic measurements program and give a summary of some of the results of the magnet testing.

27089 (NIKHEF-K-DIGEL–92-8) **Bundle profile monitor for AmPS.** Beuzekom, M.G. van; Es, J.T. van. Nationaal Inst. voor Kernfysica en Hoge-Energiefysica (NIKHEF), Amsterdam (Netherlands). Sectie K. 1992. [32p.] (In Dutch). Order Number DE93629647. Source: OSTI; NTIS; INIS.

The Bundle Profile Monitor is a measurement instrument by which the profile (cross sections) of the electron bundles of MEA are measured. The monitors are used in the injection line of AmPS to determine the bundle profile before and after the injection septum. This report gives a short description of the whole instrument, followed by a description of analogous electronics of the monitor. At the same time, this report contains the adjust-procedure of the monitor-electronics. (author). 14 figs., 1 tab.

27090 (NIKHEF-K-DIGEL–92-9) **RF-Station control crate.** Beuzekom, M.G. van; Es, J.T. van. Nationaal Inst. voor Kernfysica en Hoge-Energiefysica (NIKHEF), Amsterdam (Netherlands). Sectie K. 1992. [18p.] (In Dutch). Order Number DE93629638. Source: OSTI; NTIS; INIS.

This report gives a description of the electronic control-system for the RF-station of AmPS. The electronics form the connection between the computer-system and the hardware of the RF-station. Only the elements of the systems which are not described in the other NIKHEF-reports are here discussed in detail. (author). 7 figs.

27091 (ORNL/FTR–4299) **Travel to attend symposium on swift heavy ions in matter, a conference on electrostatic accelerators and associated boosters and a conference on applications of nuclear techniques: Foreign trip report, May 16–June 21, 1992.** Alton, G.D. Oak Ridge National Lab., TN (United States). 6 Jul 1992. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93012810. Source: OSTI; NTIS (US Sales Only); GPO Dep.

To attend the Second International Symposium on Swift Heavy Ions in Matter and present an invited paper entitled "Computational

Evaluation of the Stripping Properties of a Plasma" and a contributed paper entitled "A Scaled Sigmund Theory Model for Determining Sputter Ratios." To hold discussions with personnel at the CERN ISOLDE facility concerning operation of ISOLDE sources and procedures utilized at CERN for servicing and handling radioactively contaminated source components. To attend the Sixth International Conference on Electrostatic Accelerators and Associated Boosters and present two contributed papers entitled "Performance Characteristics of a Multiple-Sample Cesium Sputter Positive/Negative Ion Source," and "Selection and Design of the Oak Ridge Radioactive Beam Facility ISOL/Target Ion Source," and an invited paper entitled "Performance Characteristics of a Simple, High-Efficiency, Negative Surface Ionization Source." To attend the Third International Conference on Applications of Nuclear Techniques and present an invited paper entitled "Ion Sources for Use in Nuclear, Analytical, and Industrial Applications."

27092 (ORNL/FTR–4307) **Travel to France for a large experiment at the GANIL accelerator facility: Foreign trip report, June 10–24, 1992.** Beene, J.R.; Varner, R.L. Jr. Oak Ridge National Lab., TN (United States). 13 Jul 1992. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93012975. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The purpose of this travel was to make preparation for a large ORNL-led experiment to be run at GANIL in late 1992. This experiment is part of a series of four experiments to be run sequentially, which, through quite different in physics goals, use an almost identical physical layout. The specific tasks accomplished included participating in assembly and testing of detector hardware and electronics, design and implementation of the primary trigger, testing of the read-out systems, and a major contribution to the configuration and setup of the computer system.

27093 (SLAC-PUB–6098) **Design of laser-Compton spot size monitor.** Shintake, T. (National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan)); Hayano, H.; Hayakawa, A.; Ozaki, Y.; Ohashi, M.; Yasuda, K.; Waltz, D.; Wagner, S.; Burke, D. Stanford Linear Accelerator Center, Menlo Park, CA (United States). Mar 1993. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00515. (CONF-920706–54: International conference on high energy accelerators, Hamburg (Germany), 20-24 Jul 1992). Order Number DE93015599. Source: OSTI; NTIS; INIS; GPO Dep.

A new diagnostic method for measuring transverse size of electron beam by nondestructive interaction of Compton scattering of laser beam has been proposed. A first model of this spot size monitor is under construction for the FFTB – SLAC experiment, in order to measure the electron beam size of 60 nanometer vertical by 1 micrometer horizontal, using Nd: YAG-laser of 1.064 μm wavelength. In this paper, the design of the system, and essential and practical engineering problems are discussed.

27094 (SLAC-PUB–6130) **Experience with a radio frequency gun on the SSRL Injector Linac.** Weaver, J.N.; Genin, R.D.; Golceff, P.; Morales, H.; Sebek, J. Stanford Linear Accelerator Center, Menlo Park, CA (United States). Apr 1993. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00515. (CONF-930511–163: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93015600. Source: OSTI; NTIS; INIS; GPO Dep.

A-SSRL/Varian-Associates-built, one-and-a-half cavity microwave, thermionic-cathode gun has operated on the SSRL Injector Linac reliably without changing the cathode for over 10,000 hours, with no significant decrease in emission. Thus, for a pulsed electron beam, with a maximum of 0.5 A peak at 2 to 3 MeV from a 3.5 MW peak rf pulse of 2 μs pulse width at 10 pps, the apparent but small amount of back bombardment of the cathode has been tolerable. Use of a bunch-compression alpha magnet and a stripline chopper after the gun produces the required S-band 3 to 5 microbunches of electrons for injection into a standard 10-m-long linac and on into a booster synchrotron, which in turn is used to fill SPEAR. Component limitations and operating characteristics of the gun and the linac's rf system are discussed.

27095 (SLAC-PUB–6131) **Pulse modulator developments in support of klystron testing at SLAC.** Koontz, R.F.; Cassel, R.; de Lamare, J.; Ficklin, D.; Gold, S.; Harris, K. Stanford Linear Accelerator Center, Menlo Park, CA (United States). Apr 1993. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00515. (CONF-930511–165: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93015603. Source: OSTI; NTIS; INIS; GPO Dep.

Several families of high power klystrons in S- and X-Band are being developed in the Klystron Laboratory at SLAC. To support these developments, a number of new pulse modulators are being designed from scratch, or upgraded from existing laboratory test modulators. This paper outlines the modulator parameters available in the SLAC Klystron Laboratory, and discusses two new modulators that are under construction.

27096 (SLAC-PUB–6134) **Requirements for linear collider instrumentation.** Ross, M. Stanford Linear Accelerator Center, Menlo Park, CA (United States). May 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00515. (CONF-9305216–1: 1. European workshop on beam instrumentation and diagnostics for particle accelerators, Montreux (Switzerland), 3-5 May 1993). Order Number DE93015253. Source: OSTI; NTIS; INIS; GPO Dep.

Instrumentation performs a critical role in the operation of a linear collider. New acquisition and data processing techniques are required for feedback, tuning procedures and performance monitoring. For example, many collider systems are initially tuned using complex bootstrap procedures whose convergence rate will depend on the speed and performance of several instrumentation systems. Furthermore, mechanical and electrical tolerances are computed assuming the success of this process. In this paper we review the performance of specific instrumentation systems, wire scanners and beam position monitor based feedback, at the SLAC Linear Collider (SLC). Particular attention is paid to the application the lessons learned at SLC will have for future Linear Colliders.

27097 (SLAC-PUB–6138) **Proposal for a feasibility study of very large aperture quadrupole magnets.** Bjorken, J.D. (Stanford Linear Accelerator Center, Menlo Park, CA (US)); McDonald, K.T. Stanford Linear Accelerator Center, Menlo Park, CA (United States). Apr 1993. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00515. (CONF-9306176–1: Workshop on physics at current accelerators and the supercollider, Argonne, IL (United States), 2-5 Jun 1993). Order Number DE93015254. Source: OSTI; NTIS; INIS; GPO Dep.

The authors seek expert assistance in performing a feasibility study for quadrupole magnets with inner radius at least 80 cm, field at that radius of at least 1.5 Tesla, and field integral at that radius of at least 3 Tesla-m. These magnets would be used as the spectrometer magnets in hadron-collider experiments that emphasize relatively low transverse momentum and large angular coverage, such as studies of B physics and of a variety of physics topics in the far-forward direction. The magnets would preferably be superconducting, but conventional construction may be considered as well. Should the magnets be deemed feasible, the authors then seek to initiate an R and D program to construct a prototype.

27098 (SLAC-PUB–6142) **Design of the detuned accelerator structure.** Wang, J.W.; Nelson, E.M. Stanford Linear Accelerator Center, Menlo Park, CA (United States). May 1993. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00515. (CONF-930511–166: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93015604. Source: OSTI; NTIS; INIS; GPO Dep.

This is a summary of the design procedure for the detuned accelerator structure for SLAC's Next Linear Collider (NLC) program. The 11.424 GHz accelerating mode of each cavity must be synchronous with the beam. The distribution of the disk thicknesses and lowest synchronous dipole mode frequencies of the cavities in the structure is Gaussian in order to reduce the effect of wake fields. The finite element field solver YAP calculated the accelerating mode frequency and the lowest synchronous dipole mode frequency for various cavity diameters, aperture diameters and disk thicknesses. Polynomial 3-parameter fits are used to calculate the

dimensions for a 1.8 m detuned structure. The program SUPERFISH was used to calculate the shunt impedances, quality factors and group velocities. The RF parameters of the section like filling time, attenuation factor, accelerating gradient and maximum surface field along the section are evaluated. Error estimates will be discussed and comparisons with conventional constant gradient and constant impedance structures will be presented.

27099 (SLAC-PUB–6152) **The Final Focus Test Beam laser referene system.** Bressler, V.E.; Ruland, R.E. Stanford Linear Accelerator Center, Menlo Park, CA (United States). May 1993. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00515. (CONF-930511–117: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93015605. Source: OSTI; NTIS; INIS; GPO Dep.

The original design for the SLAC linac included an alignment reference system with 270 diffraction gratings situated along the 3000 meter linac. These gratings have provided SLAC with a global reference line repeatable to within 200 micro meters. For the Final Focus Test Beam, this laser system has been extended and 13 new diffraction gratings have been installed. Improvements targets and the availability of new instruments allows us to evaluate the performance of the laser reference system at the 510 micro meter level. An explanation of the system and the results of our evaluation are presented.

27100 (SSCL-Preprint–213) **Design and performance of a new 50 mm quadrupole magnet for the SSC.** Spigo, G.; Cunningham, G.; Goodzeit, C.; Orrell, D.; Turner, J.; Jayakumar, R. Superconducting Super Collider Lab., Dallas, TX (United States). Apr 1993. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930537–44: 5. annual international industrial symposium on the Super Collider and exhibition, San Francisco, CA (United States), 6-8 May 1993). Order Number DE93014078. Source: OSTI; NTIS; INIS; GPO Dep.

A superconducting quadrupole model magnet with a 50 mm aperture and a gradient of 190 T/m, in operation at 4.35 K and 6500 A, has been designed, built and tested at the SSC. This accelerator magnet is expected to have application in the interaction regions of the collider main rings. Its dipole-type stainless steel collars with mated self-aligning pole spacers were a major innovation in design. The model had stringent requirements on field quality and a conservative 21% current margin. The first two articles have now demonstrated satisfactory quench performance over several thermal cycles, reaching plateau at approximately 8660 A with minimal training. This paper is a brief sketch of the design and preliminary results on the first model. Fabrication and testing are described in other papers of this conference.

27101 (SSCL-Preprint–214) **The accelerator systems string test: Objectives, problems, results, anecdotes, and reflections.** Dombeck, T. Superconducting Super Collider Lab., Dallas, TX (United States). Apr 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930537–27: 5. annual international industrial symposium on the Super Collider and exhibition, San Francisco, CA (United States), 6-8 May 1993). Order Number DE93014166. Source: OSTI; NTIS; INIS; GPO Dep.

The Accelerator System String Test (ASST) was a congressionally mandated milestone for the Superconducting Super Collider Laboratory (SSCL) to demonstrate powered operation of a half-cell of industrially-fabricated collider magnets before mass production could begin. In this paper I describe the installation of the string components and the results from the full-powered tests of the magnet string, consisting of five dipole magnets having an aperture of 50 mm and a single quadrupole having an aperture of 40 mm. Power and cryogenic connections were made to the string through spool pieces that were prototypes for SSC operations. The string was cooled to cryogenic temperatures in early July, 1992 and power tests were performed at progressively higher currents up to the nominal SSC operating point near 6500 Amperes.

27102 (SSCL-Preprint–218) **Integrating PAW, a graphical analysis interface to Sybase.** Fry, A.; Chow, I. Superconducting Super Collider Lab., Dallas, TX (United States). Apr 1993. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930537–35: 5. annual international industrial symposium on the Super Collider and exhibition, San Francisco, CA (United States), 6-8 May 1993). Order Number DE93014172. Source: OSTI; NTIS; INIS; GPO Dep.

The program PAW (Physics Analysis Workstation) enjoys tremendous popularity within the high energy physics community. It is implemented on a large number of platforms and is available to the high energy physics community free of charge from the CERN computing division. PAW combines extensive graphical display capability (HPLOT/HIGZ), with histogramming (HBOOK4), file and data handling (ZEBRA), vector arithmetic manipulation (SIGMA), user defined functions (COMIS), powerful function minimization (MINUIT), and a command interpreter (KUIP). To facilitate the possibility of using relational databases in physics analysis, we have added an SQL interface to PAW. This interface allows users to create PAW N-tuples from Sybase tables and vice versa. We discuss the implementations below.

27103 (SSCL-Preprint–222) **Experimental strength verification of SSC cryogenic transfer line internal suspension system.** Stifle, K.; Zhang, B. Superconducting Super Collider Lab., Dallas, TX (United States). Apr 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930537–26: 5. annual international industrial symposium on the Super Collider and exhibition, San Francisco, CA (United States), 6-8 May 1993). Order Number DE93014167. Source: OSTI; NTIS; INIS; GPO Dep.

A transfer line system and support structure has been proposed by Zhang and Stifler and Zhang. The support structure uses three composite (G-10) plates to support the seven cryogenic lines. The cryogenic lines range in temperature from 80 K to 4 K. There are two 80 K nitrogen lines, two 20 K vapor helium lines, and three 4 K helium lines. The 80 K lines are attached to one plate, the 20 K lines are attached to another plate and the 4 K lines are attached to the last plate. Stainless steel rods are used to connect the plates to each other. This arrangement results in essentially three different temperature levels: an 80 K plate, a 20 K plate, and a 4 K plate. There are three different support structures; an elbow support, a longitudinal support, and a radial support. The main difference between the structures is the thickness of the plates. The elbow support is the thickest because it must carry the largest load and the radial support is the thinnest because it carries the lightest load. There are slight differences in the 80 K plates of each support but the 4 K and 20 K plates remain virtually unchanged except for the thickness. The 80 K plate of the elbow support has more "tabs" which are used to attach it to the vacuum vessel than the 80 K plate of the longitudinal support. The 80 K plate of the radial support is not attached to the vacuum vessel but has rollers which allow it to move as the tubes expand and contract with temperature changes. Only the elbow and longitudinal supports were tested.

27104 (SSCL-Preprint–224) **Heat leak measurements and thermal modeling of a mechanical support for a SSC beam tube liner.** Maddocks, J.; Zbasnik, J.; Yuecel, A.; Spidle, R. Superconducting Super Collider Lab., Dallas, TX (United States). Apr 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930537–38: 5. annual international industrial symposium on the Super Collider and exhibition, San Francisco, CA (United States), 6-8 May 1993). Order Number DE93014169. Source: OSTI; NTIS; INIS; GPO Dep.

Hydrogen desorbed from the beam tube of the super collider by synchrotron radiation may adversely affect the luminosity lifetime of the proton beam. One solution to this problem is to place a distributed cryopump within the beam tube which will pump desorbed gasses. Such a cryopump can be effected by attaching cryosorber to the cold (4 K) magnet bore tube. A concentric tube, or liner, centered within the magnet bore tube shields the cryosorber from the synchrotron radiation, and becomes the beam tube. By perforating a fraction of the liner surface with small (on the order of 1–3 mm) holes, the liner/cryosorber assembly becomes a distributed pump. The liner temperature may be allowed to equilibrate at a temperature close to that of the 4 K bore tube. However, actively stationing the liner at 80 K is of interest because the synchrotron radiation heat can then be deposited in the liquid nitrogen system.

This, at least partially, decouples the allowable beam current from the helium cryogenic system. Active control is accomplished by means of 80 K helium flowing through a trace tube attached to the outside of the liner.

27105 (SSCL-Preprint–232) **The thermal behavior of an SSC magnet in an unconditioned outdoor environment.** Pletzer, R. Superconducting Super Collider Lab., Dallas, TX (United States). Apr 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930537–28: 5. annual international industrial symposium on the Super Collider and exhibition, San Francisco, CA (United States), 6-8 May 1993). Order Number DE93014165. Source: OSTI; NTIS; INIS; GPO Dep.

The superconducting coils of the SSC magnets are subjected to potentially harmful warm temperatures during transportation and storage operations in certain outdoor environments. A realistic, harmful operating environment to which a magnet could be subjected at some point in the SSC construction would occur in the scenario in which an uncovered magnet remains outdoors during a hot, bright summer day, without environmental conditioning or protection for an extended period. Such a scenario could occur during a transportation truck breakdown, or if a magnet were left outside awaiting entry to the construction shaft over a weekend, for example. The magnet would be subjected to elevated ambient temperatures and solar radiation which could heat the magnet and raise the coil and bus assembly at some location to a temperature greater than the 32.2 °C (90°F), at which the B-stage epoxy used in the coil ground plane insulation is thought to weaken. A thermal analysis of an FNAL 50mm Dipole style magnet under such a hypothetical operating condition was conducted to predict the maximum coil temperature rise and rate of rise during such a scenario.

27106 (SSCL-Preprint–233) **A study of structural integrity of the SSC magnet six-strut support system.** Chang, C.; Chen, S.; Jalloh, A.; Martin, D. Superconducting Super Collider Lab., Dallas, TX (United States). Apr 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930537–30: 5. annual international industrial symposium on the Super Collider and exhibition, San Francisco, CA (United States), 6-8 May 1993). Order Number DE93014161. Source: OSTI; NTIS; INIS; GPO Dep.

In the preliminary SSC design configuration, the overall magnet cryostat assembly is supported externally at three mechanical positioning points by two stands attached to the collider tunnel floor. Differing from the SSC design concept, a well designed and simply operated six-strut support system has been used at the Lawrence Berkeley Laboratory/Advanced Light Source (LBL/ALS) successfully. In brief, the struts are equipped with ball joints at each end, and the struts are so arranged in a manner of three vertical, two lateral, and one longitudinal directions that provide the minimum constraints necessary to support the ALS system in the accelerator tunnel. Because the struts are made of differential screws which are adjustable in length, the six-strut system also provides minute controllability for cryostat alignment purposes. Also, the six-strut support system keeps the magnet from direct exposure to the accelerator tunnel floor which may lower the potential risks for the magnet from the ambient vibration and ground motion. Because of the mentioned merits, the six-strut support configuration is being considered as an alternative to the SSC magnet support system. This paper presents a qualitative study for the structural integrity of the SSC six-strut support system. Several six-strut design configurations are investigated.

27107 (SSCL-Preprint–234) **A quasi-3D model to predict temperature distribution in SSC magnets due to 3D heat loads.** Archer, B. (Superconducting Super Collider Lab., Dallas, TX (United States)); Schermer, R.; Snitchler, G.; Kohli, H. Superconducting Super Collider Lab., Dallas, TX (United States). Apr 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930537–50: 5. annual international industrial symposium on the Super Collider and exhibition, San Francisco, CA (United States), 6-8 May 1993). Order Number DE93014249. Source: OSTI; NTIS; INIS; GPO Dep.

Hadronic and electromagnetic cascades in the vicinity of the interaction regions deposit energy into the final focusing superconducting magnets as a heat load that varies radially, azimuthally, and axially. The helium used to cool the magnets convects heat axially as it flows, thus, the temperature distribution at any point in the magnet depends on the previous history of the helium. A detailed map of the temperature distribution of the superconducting coils is required to determine the cooling is sufficient to prevent the magnet from quenching. A three-dimensional model is required to analyze the magnet temperature distribution due to the 3D heat load and the axial helium flow A 3D finite element thermal model of a 15 m magnet is not practical due to the large amount of CPU time that would be required. Therefore, a quasi-3D model has been developed that divides the magaet into a large number of segments axially, then calculates the temperature distribution for each segment using a 2D finite element model with boundary conditions derived from the previous segment by conservation of energy.

27108 (SSCL-Preprint–236) **Data acquisition and controls for the SSCL ASST, Phase 1.** Bork, R.; Christiansen, M.; Faught, E.; Goetze, K.; Haenni, D.; Lee, S.; Murray, D.; Wang, J.; Williams, E.; Wylie, M.; Zatopek, J. Superconducting Super Collider Lab., Dallas, TX (United States). Apr 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930537–33: 5. annual international industrial symposium on the Super Collider and exhibition, San Francisco, CA (United States), 6-8 May 1993). Order Number DE93014076. Source: OSTI; NTIS; INIS; GPO Dep.

The Accelerator Systems String Test (ASST) was a major milestone in SSCL R&D. Phase I demonstrated that the smallest repetitive sequence of bending magnets (a half cell) could be installed, leak checked, cooled to liquid helium temperatures, energized, and safely quenched. To support this activity, a control system had to be developed to operate and monitor cryogenic systems in the string, along with LCW and vacuum systems. Also, since this is a test facility, the magnet systems were heavily instrumented to provide sufficient data to confirm that design requirements were met, that the system was operating safely and as expected, and allow further design studies necessary for the construction of the SSC. This required the design and implementation of an acquisition system capable of collecting relatively large amounts of data, at various data rates, and presenting this data both to operations personnel and to a database for off-line analysis. In this paper, we describe the design, implementation, and operation of the data acquisition system and controls employed on the ASST.

27109 (SSCL-Preprint–242) **Design and results of the radio frequency quadrupole RF system at the Superconducting Super Collider Laboratory.** Grippe, J. (Superconducting Super Collider Lab., Dallas, TX (United States)); Marsden, E.; Marrufo, O.; Regan, A.; Rees, D.; Ziomek, C. Superconducting Super Collider Lab., Dallas, TX (United States). May 1993. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930511–53: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014254. Source: OSTI; NTIS; INIS; GPO Dep.

The Superconducting Super Collider Laboratory (SSCL) and the Los Alamos National Laboratory (LANL) entered into a joint venture to design and develop a 600 kW amplifier and its low-level controls for use in the Radio-Frequency Quadrupole (RFQ) accelerating cavity of the SSC. The design and development work has been completed. After being tested separately, the high power amplifier and low level RF control system were integrated and tested on a test cavity. Results of that tests are given. Tests were then carried out on the actual RFQ with and without the presence of the accelerated beam. Results of these tests are also given, along with the phase and amplitude information.

27110 (SSCL-Preprint–246) **FDDI experience at the SSCL.** Jaffe, M. Superconducting Super Collider Lab., Dallas, TX (United States). Apr 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930537–15: 5. annual international industrial symposium on the Super Collider and exhibition, San Francisco, CA (United States), 6-8 May 1993). Order Number DE93014132. Source: OSTI; NTIS; INIS; GPO Dep.

The Physics Detector Simulation Facility (PDSF) is an assemblage of UNIX/RISC workstations and servers which use LAN

networking components and standards in a unique way. The PDSF is configured using FDDI much like an internal system bus to a computer system and thus serves as the foundation for the entire PDSF system. This paper will describe the utilization of FDDI in the system, system monitoring, and the interfacing of the PDSF to the local site LAN and WAN environment.

27111 (SSCL-Preprint–247) **Preliminary results from a study of collar lamination variation in SSC Prototype Dipole Magnets.** Gattu, R.; Brown, G.M.; Pollock, D. Superconducting Super Collider Lab., Dallas, TX (United States). Apr 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930537–37: 5. annual international industrial symposium on the Super Collider and exhibition, San Francisco, CA (United States), 6-8 May 1993). Order Number DE93014170. Source: OSTI; NTIS; INIS; GPO Dep.

The collar laminations used in SSC Prototype Collider Dipole Magnets determine the, volume within which the magnet coils are constrained after collaring and keying. The uniformity and symmetry of the inside volume of the collars along the length of the magnet may have a significant influence on the field quality of the finished assembly. This pap describes an on-going Statistical Quality Control study of collar lamination dimension variation being performed by SSCL Magnet Systems Division Quality Assurance. Samples of collars have been measured using a coordinate measuring machine evaluate manufacturing process capability as well as the overall uniformity of the inven population of collar laminations. The collar data will be used to predict variation in the coil assembly center and radius for inner and outer top-bottom, left-right coil combinations well as pole angles. Collar results will be combined with azimuthal coil size measure melits part of a manufacturing cause and effect model for predicting axial geometric multipoles ba on the observed mechanical variation. This work focuses on Prototype Collider Dipole Magnet DCA 102 currently being built at the SSCL MDL in Waxahachie, Texas. This magnet is being made on the same coil curing and collaring mold cavities that were used for the DCA 300 series magnets built at FNAL in 1991–1992 and which were later used in the 1992 Accelerator Systems String Test (ASST). The collars are part of the same procurement used for the DCA300 series magnets.

27112 (SSCL-Preprint–248) **MTL distributed magnet measurement system.** Nogiec, J.M.; Craker, P.A.; Garbarini, J.P.; Ilushin, V.; Ivey, J.C.; Lambert, J.D.; Li, Wei-chuan. Superconducting Super Collider Lab., Dallas, TX (United States). Apr 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930537–41: 5. annual international industrial symposium on the Super Collider and exhibition, San Francisco, CA (United States), 6-8 May 1993). Order Number DE93014311. Source: OSTI; NTIS; INIS; GPO Dep.

The Magnet Test Laboratory (MTL) at the Superconducting Super collider Laboratory will be required to precisely and reliably measure properties of magnets in a production environment. The extensive testing of the superconducting magnets comprises several types of measurements whose main purpose is to evaluate some basic parameters characterizing magnetic, mechanic and cryogenic properties of magnets. The measurement process will produce a significant amount of data which will be subjected to complex analysis. Such massive measurements require a careful design of both the hardware and software of computer systems, having in mind a reliable, maximally automated system. In order to fulfill this requirement a dedicated Distributed Magnet Measurement System (DMMS) is being developed.

27113 (SSCL-Preprint–251) **Cryogenic characteristics of the SSC Accelerator Systems String Test (ASST).** Burgett, W.; Franks, D.; Kraushaar, P.; Levin, M.; McAshan, M.; McInturff, A.; Pletzer, R.; Revell, D.; Robinson, W.; Saladin, V.; Shuy, G.; Smellie, R.; Weisend, J.G. II. Superconducting Super Collider Lab., Dallas, TX (United States). Apr 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930537–39: 5. annual international industrial symposium on the Super Collider and exhibition, San Francisco, CA (United States), 6-8 May 1993). Order Number DE93014168. Source: OSTI; NTIS; INIS; GPO Dep.

A series of static and dynamic tests of the ASST were conducted from July 1992 to the present. These tests included heat leak measurements, as well as, temperature and pressure profiles obtained during quench testing of the string. An accurate assessment of heat leak measurements of collider components requires a stable thermal environment with the minimization of end effects. The string test provides the ideal static environment necessary to conduct these measurements. This report summarizes the results of the heat leak measurements conducted on the cold mass, 20K, and 80K shields of the dipoles used in the ASST assembly. We also report on the rapidly changing temperatures and pressures recorded during the string quench tests.

27114 (SSCL-Preprint–257) **Beam instrumentation and precision timing equipment for the SSC accelerator complex.** Webber, R. Superconducting Super Collider Lab., Dallas, TX (United States). Apr 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930537–42: 5. annual international industrial symposium on the Super Collider and exhibition, San Francisco, CA (United States), 6-8 May 1993). Order Number DE93014074. Source: OSTI; NTIS; INIS; GPO Dep.

This article is intended to provide an introduction to the beam instrumentation systems and the precision timing system of the SSC Laboratory. The Beam Instrumentation Department of the SSC Accelerator Systems Division is responsible for the design of these systems for the Collider rings and the injecter accelerators. Status and plans are briefly described. The signal sensors and low level signal processing electronics of the beam instrumentation systems are the eyes and ears into the world of the proton beam. Situated between that invisible beam and the accelerator operator, they monitor and measure the behavior and performance of the otherwise intangible protons as they are guided and accelerated through the Linac and the injecter synchrotrons, and finally stored in the Collider rings. The precision timing system provides the vital time references required to synchronize critical accelerator hardware functions, beam manipulations, and data acquisition over the geographical extent of the Supercollider complex. Several fundamental timing signals are distributed over dedicated fiber optic networks. Special programmable electronic modules process the timing information to provide precisely timed outputs to control the many accelerator systems and devices.

27115 (SSCL-Preprint–266) **Design and analysis of the Collider SPXA/SPRA spool piece vacuum barrier.** Cruse, G.; Aksel, G. Superconducting Super Collider Lab., Dallas, TX (United States). Apr 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930537–32: 5. annual international industrial symposium on the Super Collider and exhibition, San Francisco, CA (United States), 6-8 May 1993). Order Number DE93014176. Source: OSTI; NTIS; INIS; GPO Dep.

A design for the Collider SPXA/SPRA spool piece vacuum barrier was developed to meet a variety of thermal and structural performance requirements. Both composite and stainless steel alternatives were investigated using detailed finite-element analysis before selecting an optimized version of the ASST SPR spool vacuum barrier design. This design meets the structural requirements and will be able to meet the thermal performance requirements by using some newer thermal strapping configurations.

27116 (SSCL-Preprint–268) **Technical status of SSC RF amplifier and accelerating cavity systems.** Ferrell, J.; Rogers, J.; Coleman, P.; Curbow, J.; Mynk, J. Superconducting Super Collider Lab., Dallas, TX (United States). Apr 1993. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930537–31: 5. annual international industrial symposium on the Super Collider and exhibition, San Francisco, CA (United States), 6-8 May 1993). Order Number DE93014175. Source: OSTI; NTIS; INIS; GPO Dep.

An overview of the design status of each RF amplifier system is presented and potential opportunities for industry involvement are identified. Specifically, brief descriptions of the LINAC, LEB, MEB, HEB, and Collider RF Amplifier systems are presented, as well as the LEB and MEB cavities. Status in the LINAC ranges from an RFQ Amplifier being operational at the SSC to procurement of subsystems still pending. The LEB prototype system is in tests at

SSC, and the MEB prototype system is has begun, and desip of the MEB RF system will begin in 1994.

27117 (SSCL-Preprint–271) **The design and development of a single piece, sandwhich tube coldmass support post for the SSC Collider Dipole Magnets.** Ahmad, A. (Superconducting Super Collider Lab., Dallas, TX (United States)); Mehle, G. Superconducting Super Collider Lab., Dallas, TX (United States). Apr 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930537–47: 5. annual international industrial symposium on the Super Collider and exhibition, San Francisco, CA (United States), 6-8 May 1993). Order Number DE93014252. Source: OSTI; NTIS; INIS; GPO Dep.

This paper presents the design and development of the single piece, carbon/epoxy syntactic core sandwich tube support post concept for the 13-m and 15-m Collider Dipole Magnet (CDM). The engineering studies focus on balancing the structural and thermal requirements for the structure, and most importantly the implicit requirement of "Designing for Producibility." Results from these studies, as well as the development program plan, will be presented.

27118 (SSCL-Preprint–275) **Design of a model dipole magnet for the SSC High Energy Booster.** Hassan, N.; Couzens, K.; Dwyer, S.; Jaisle, A.; Jayakumar, R.; Krishnamurthy, S.; Mihelic, R.; Phillips, S.; Puri, R.K.; Sarna, K.; Snitchler, G.; Venkatraman, V. Superconducting Super Collider Lab., Dallas, TX (United States). Apr 1993. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930537–40: 5. annual international industrial symposium on the Super Collider and exhibition, San Francisco, CA (United States), 6-8 May 1993). Order Number DE93014134. Source: OSTI; NTIS; INIS; GPO Dep.

A superconducting model dipole magnet has been designed to serve as a vehicle in an R&D program to develop a dipole magnet for potential use in the SSC High Energy Booster. The objective has been to use the Brookhaven, National Laboratory (BNL) and Fermi National Accelerator Laboratory (FNAL) 50 mm aperture dipole designs to the maximum possible extent for design of a dipole magnet with the same size aperture and a field intensity of 6.67 T. Objectives of this program have also included an evaluation of magnet cross section designs which provides in margin and includes a field quality iteration on BNL and FNAL dipole designs. In this paper the 2D magnetic and mechanical design of the cold mass in conceptual and detail form is presented.

27119 (SSCL-Preprint–278) **Dynamic analysis of six-strut supporting system for accelerator magnet.** Leung, K.K. Superconducting Super Collider Lab., Dallas, TX (United States). Apr 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930511–28: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014245. Source: OSTI; NTIS; INIS; GPO Dep.

A six-strut magnet support system designed by Lawrence Berkeley Laboratory (LBL) is considered as an alternative to the current SSC magnet support system. The LBL designed a six-strut support system based on the kinematics mount concept that is generally used in the optical and the laser communication industries. The six-strut system is defined by six static degrees of freedom that constrain a point in space with no redundant restraint. Adjustment of any strut's length means redefining the translation or rotational degree of freedom of the mounting point and produces the desirable movement of the magnet system. The accurately operated six-strut mounting system used in the Berkeley's Advance Light Source (AILS) magnet support is able to maintain the magnet system structural integrity to survive a 7 earthquake, position the magnet to high tolerances, have a small footprint, simple to operate, and adjust to a micron level of accuracy. Though finite element simulation has been used for years in safety analysis, such as seismic dynamic response analysis in nuclear reactor and piping supports, in late 1970, it was employed in the dynamic study for a magnet system in Lawrence Berkeley Laboratory in the late eighties. The modeling methodology developed in LBL for the six-strut system desip, especially for the critical mounting joint design under dynamic loads, is presented in this paper and may be employed for prospective SSC accelerator magnet supporting system design.

27120 (SSCL-Preprint–281) **Databases for analysis of superconducting cable manufacturing.** Bardos, V.A.; Coleman, E.S.; Erdmann, M.J.; Jones, B.A.; Kozman, K.S.; Little, D.J.; Seuntjens, J.M. Superconducting Super Collider Lab., Dallas, TX (United States). Apr 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930537–49: 5. annual international industrial symposium on the Super Collider and exhibition, San Francisco, CA (United States), 6-8 May 1993). Order Number DE93014250. Source: OSTI; NTIS; INIS; GPO Dep.

Starting in September 1991, eight cable vendors began fabricating approximately 10,000 kg each of Inner or Outer superconducting cable for the Superconducting Super Collider's (SSC) cable Vendor Qualification Program (VQP). This program, designed to identify vendor's for competition for the supplying of superconducting cable for the manufacture of SSC magnet systems, will conclude in June, 1993. The conductor database was developed as an integral part of the VQP in order to analyze the origins of variation within the conductor fabrication processes, and develop and implement control procedures to minimize such variations. In addition, the database development effort will provide a direct link to the MAGCOM database system being implemented by the Test and Data Management Department of the Magnet Systems Division of the SSCL.

27121 (SSCL-Preprint–284) **Optical measurement of SSC ARC quadrupole cold mass location.** Corbett, C. (Superconducting Super Collider Lab., Dallas, TX (United States)); Ketcham, L.; Pletzer, R.; Shapiro, S.; Viola, R.; Walton, J.; Wilkins, R.; Bagwell, S.; Barnes, W. Superconducting Super Collider Lab., Dallas, TX (United States). Apr 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930537–18: 5. annual international industrial symposium on the Super Collider and exhibition, San Francisco, CA (United States), 6-8 May 1993). Order Number DE93014130. Source: OSTI; NTIS; INIS; GPO Dep.

The operation of the collider requires that the ARC quadrupoles' beam center and rotational configuration be held to the tight tolerances of 0.2 mm rms and 0.5 mradian rms. The design of the collider superconducting magnets prevents direct access to the cold mass during operation. As a result, cold mass position is inferred from the relationship established by warm measurements relative to a secondary fiducial located on the vacuum vessel and an offset (warm to cold correlation) to account for the position change for a cold magnet. There is concern am the relation of these fiducials to the magnet centerline may change unpredictably due to the temperature drop required for superconducting operation or due to long term creep. This paper reports on a design that will allow visual observation of the cold mass shell position and roll orientation under cold as well as warm conditions. This paper will present a description of the window configuration and status/results of tests which have been conducted warm and cold in the single magnet configuration. Future testing in a multiple string configuration is being considered.

27122 (SSCL-Preprint–285) **Conceptual design studies for a He II cooled Low Beta Quad IR Magnets.** Baritchi, D.; Corbett, C.; Jalloh, A.; Mokhov, N.V.; Schermer, R.; Steining, R. Superconducting Super Collider Lab., Dallas, TX (United States). Apr 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930537–51: 5. annual international industrial symposium on the Super Collider and exhibition, San Francisco, CA (United States), 6-8 May 1993). Order Number DE93014248. Source: OSTI; NTIS; INIS; GPO Dep.

This paper discusses the results of the Cryostat Design Group's effort on the Conceptual Studies of the Low Beta Quad Magnets (LBQ) cooled by superfluid Helium (He II). The conclusion of this study is that the "adapted CERN' He H cooling design does present a satisfactory system for cooling the LBQ magnet interaction region (IR) radiation heat loads; however, for the increased luminosity heat load some research on the cable insulator is required to achieve an effective thermal connection between the outer coil and the He II bath. The LBQ magnets are the final four magnets on either side of the IR detector. These four magnets are

named Q1, Q2A, Q2B, and Q3, reaching outward from the interaction point. All magnets have a 50-mm magnet bore and produce a gradient of 193 T/m. Magnetic lengths were all-considered to be 15 meters for the purposes of this study. Radiation from the proton-proton collisions results in a significant heat deposition on the LBQs which is most severe for Q1 and least severe for Q2 and Q3. This is reduced with a 25-mm aperature, 3 meter long steel collimator installed upstream of Q1. Total heat to be removed from Q1 is 47 watts at the baseline luminosity which presents the most severe design challenge.,V Maximum local heat deposition is 0.25 mw/g. The average value for the inner coil compared to the worst 2.5-meter length is 1.01 w/m average compared to 2.24 w/m maximum. The thermal model results were generated for both the maximum heat loads and the average heat load. The design loads for the 10^{34} luminosity design can be obtained by multiplying the above values by ten. The assumption has been made that a cooling collimator is installed inside the beam tube along the entire length of the magnets to absorb one-half of the total heat load for the increased luminosity design.

27123 (SSCL-Preprint–288) **Building the repositories to serve.** Lersch, D. Superconducting Super Collider Lab., Dallas, TX (United States). Apr 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930511–90: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014100. Source: OSTI; NTIS; INIS; GPO Dep.

The project to design and build the Superconducting Super Collider (SSC) Laboratory also includes the exciting opportunity to implement client/server information systems. Lab technologists were eager to take advantage of the cost savings inherent in the open systems and a distributed, client server environment and, at the same time, conscious of the need to provide secure repositories for sensitive data as well as a schedule sensitive acquisition strategy for mission critical software. During the first year of project activity, micro-based project management and business support systems were acquired and implemented to support a small study project of less than 400 people allocating contracts of less than $1 million. The transition to modern business systems capable of supporting more than 10,000 participants (world wide) who would be researching and developing the new technologies that would support the world's largest scientific instrument, a 42 Tevatron, superconducting, super collider became a mission critical event. This paper will present the SSC Laboratory's strategy to balance our commitment to open systems, structured query language (SQL) standards and our success with acquiring commercial off the shelf software (COTS) to support our immediate goals. Included will be an outline of the vital roles played by other labs (Livermore, CERN, Brookhaven, Fermi and others) and a discussion of future collaboration potentials to leverage the information activities of all Department of Energy (DOE) funded labs.

27124 (SSCL-Preprint–289) **Systematic error analysis of rotating coil using computer simulation.** Li, Wei-chuan; Coles, M. Superconducting Super Collider Lab., Dallas, TX (United States). Apr 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930537–72: 5. annual international industrial symposium on the Super Collider and exhibition, San Francisco, CA (United States), 6-8 May 1993). Order Number DE93016186. Source: OSTI; NTIS; INIS; GPO Dep.

This report describes a study of the systematic and random measurement uncertainties of magnetic multipoles which are due to construction errors, rotational speed variation, and electronic noise in a digitally bucked tangential coil assembly with dipole bucking windings. The sensitivities of the systematic multipole uncertainty to construction errors are estimated analytically and using a computer simulation program.

27125 (SSCL-Preprint–300) **Comparisons of processes and performance of SSC-VQP material.** Seuntjens, J.; Clark, F.; Erdmann, M.; Coleman, E.; Jones, B. Superconducting Super Collider Lab., Dallas, TX (United States). May 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930511–89: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014102. Source: OSTI; NTIS; INIS; GPO Dep.

The Superconducting Super Collider's (SSC) cable Vendor Qualification Program (VQP) will end in FY 1993. At the time of this writing, all 8 vendors involved in this program have demonstrated capability to fabricate conductor which meets SSC specifications. The magnet vendors have hard choices to make in calendar year 1993 in deciding which cable vendors will make the production cable. It is well accepted that because of requirements of magnet uniformity, that only one vendor will be chosen for dipole Inner cable, one vendor for dipole Outer cable, and one vendor for quadrupole Outer cable. The production quantities are nominally 500, 500, and 200 metric tonnes, respectively. Among the many deciding factors are a technically sound production process, process control, and production quantity capability of each cable vendor. Qualified vendors will have proven their technical process and process control is adequate for production quantities. This paper is part of ongoing effort to provide technical information for the magnet vendor's decision making process. Some of the Phase IB process data is summarized and well as results of a portion of the materials characterization performed at the SSC Laboratory. Key process and final product parameters for each cable vendor are compared without identifying specific vendor's process detail.

27126 (SSCL-Preprint–308) **Thermal analysis of the SSC beam scraper.** Tran, N.; Dao, B. Superconducting Super Collider Lab., Dallas, TX (United States). Apr 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930537–48: 5. annual international industrial symposium on the Super Collider and exhibition, San Francisco, CA (United States), 6-8 May 1993). Order Number DE93014251. Source: OSTI; NTIS; INIS; GPO Dep.

When a particle beam impacts a beam scraper, heat is generated resulting in a rise in the temperature of the material. The maximum temperature rise should be kept to a minimum in order to maintain scraper efficiency and performance. In this paper the results of a thermal analysis of a scraper are presented.

27127 (SSCL-Preprint–312) **On coupling impedances of pumping holes.** Kurennoy, S. Superconducting Super Collider Lab., Dallas, TX (United States). Apr 1993. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930511–120: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014253. Source: OSTI; NTIS; INIS; GPO Dep.

Coupling impedances of a single small hole in vacuum-chamber walls have been calculated at low frequencies. To generalize these results for higher frequencies and/or larger holes one needs to solve coupled integral equations for the effective currents. These equations are solved for two specific hole shapes. The effects of many holes at high frequencies where the impedances are not additive are studied using a perturbation-theory method. The periodic versus random distributions of the pumping holes in the Superconducting Super Collider liner are compared.

27128 (SSCL-Preprint–328) **Beam loss handling at the SSC.** Baishev, I.S.; Drozhdin, A.I.; Mokhov, N.V. Superconducting Super Collider Lab., Dallas, TX (United States). May 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930511–205: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93016243. Source: OSTI; NTIS; INIS; GPO Dep.

A scraper/collimation system is required to localize the beam loss in the Collider of the Superconducting Super Collider to a few predefined locations and by doing so to minimize the irradiation of superconducting magnets, to sustain favorable background conditions in the Interaction Regions (IR), and to reduce the impact of radiation on other equipment, personnel, and the environment. Results of full-scale simulation are presented for various systematic and accidental beam loss.

27129 (SSCL-Preprint–329) **Dealing with abort kicker prefire in the Superconducting Super Collider.** Drozhdin, A.I.; Baishev, I.S.; Mokhov, N.V.; Parker, B.; Richardson, R.D.; Zhou, J. Superconducting Super Collider Lab., Dallas, TX (United States). May 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930511–61: International particle accelerator conference, Washington, DC (United

States), 17-20 May 1993). Order Number DE93014083. Source: OSTI; NTIS; INIS; GPO Dep.

The Superconducting Super Collider uses a single-turn extraction abort system to divert the circulating beam to a massive graphite absorber at normal termination of the operating cycle or in case of any of a number of predefined fault modes. The Collider rings must be designed to be tolerant to abort extraction kicker prefires and misfires because of the large circulating beam energy. We have studied the consequences of beam loss in the accelerator due to such prefires and misfires in terms of material heating and radiation generation using full scale machine simulations and Monte-Carlo energy deposition calculations. Some results from these calculations as well as possible protective measures for minimizing the damaging effects of kicker prefire and misfire are discussed in this paper.

27130 (SSCL-Preprint–337) **An engineering design study of the transfer bridge for the SSC SDC detector.** Western, J.L. (Superconducting Super Collider Lab., Dallas, TX (United States)); Tulk, G.W.; Dittert, L.I. Superconducting Super Collider Lab., Dallas, TX (United States). May 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930537–59: 5. annual international industrial symposium on the Super Collider and exhibition, San Francisco, CA (United States), 6-8 May 1993). Order Number DE93016113. Source: OSTI; NTIS; INIS; GPO Dep.

The transfer bridge is a major structural installation component for the large detector proposed by the Solenoidal Detector Collaboration (SDC). The transfer bridge is the structural device that allows for installation of the Muon Forward Toroid (MFT) and calorimeter components into the Muon Barrel Toroid (MBT). This paper summarizes the design and construction of the SDC transfer bridge.

27131 (SSCL-Preprint–347) **Overview and status of beam instrumentation at the SSC.** Webber, R.C. Superconducting Super Collider Lab., Dallas, TX (United States). May 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930511–65: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014081. Source: OSTI; NTIS; INIS; GPO Dep.

An overview of beam instrumentation requirements at the SSC and a status report on work progress is given. Small transverse emittance beams, ranging in energy from 30 KeV to 20 TeV, must be commissioned, measured, and diagnosed. Instrumentation plans and current design and development efforts for BPMs and other systems are presented. Monitors and electronics soon to be delivered for use in the Linac are described. Design of the Linac systems has been done with requirements and applications in the synchrotron in mind and thus should provide a basis for design of much of that hardware. The useful commonality of design across the machines is discussed.

27132 (SSCL-Preprint–348) **Conductor design for the GEM Detector Magnet.** Minervini, J.V. (Massachusetts Inst. of Tech., Cambridge, MA (United States). Plasma Fusion Center); Marston, P.G.; Smith, B.A.; Camille, R.J.; Piek, Z.S.; Vieira, R.F.; Titus, P.; Deis, G.; Martovetsky, N.; Reardon, P.J.; Stroynowski, R. Superconducting Super Collider Lab., Dallas, TX (United States). May 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930537–58: 5. annual international industrial symposium on the Super Collider and exhibition, San Francisco, CA (United States), 6-8 May 1993). Order Number DE93016116. Source: OSTI; NTIS; INIS; GPO Dep.

Short communication. SHOWER COUNTERS/superconducting cables; SUPERCONDUCTING CABLES/design; SUPERCONDUCTING SUPER COLLIDER; SUPERCONDUCTING MAGNETS; TESTING; DESIGN

27133 (SSCL-Preprint–350) **The SSCL LINAC Control System.** Heefner, J.; Cuevas, C.; Hunt, S.; Murray, D.; Sage, J. Superconducting Super Collider Lab., Dallas, TX (United States). May 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930511–204: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93016187. Source: OSTI; NTIS; INIS; GPO Dep.

Short communication. SUPERCONDUCTING SUPER COLLIDER/linear accelerators; LINEAR ACCELERATORS/computerized control systems; COMMUNICATIONS; COMPUTER NETWORKS

27134 (SSCL-Preprint–352) **Electron beam emittance monitor for the SSC.** Tsyganov, E.; Meinke, R.; Nexsen, W.; Kauffmann, S.; Zinchenko, A.; Taratin, A. Superconducting Super Collider Lab., Dallas, TX (United States). May 1993. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930511–121: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014244. Source: OSTI; NTIS; INIS; GPO Dep.

A nondestructive beam profile monitor for the Superconducting Super Collider (SSC) is presented using as a probe a low-energy electron beam interacting with the proton bunch charge. Results using a full Monte Carlo simulation code look promising for the transverse and longitudinal beam profile measurements.

27135 (SSCL-Preprint–354) **Status of the SSC LEB rf cavity.** Coleman, P.C. (Superconducting Super Collider Lab., Dallas, TX (United States)); Brandeberry, F.; Friedrichs, C.; Goren, Y.; Grimm, T.; Hulsey, G.; Kwiatkowski, S.; Propp, A.; Taylor, L.; Walling, L.; Averbukh, J.; Karliner, M.; Petrov, V.; Yakovlev, S. Superconducting Super Collider Lab., Dallas, TX (United States). May 1993. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930511–40: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014271. Source: OSTI; NTIS; INIS; GPO Dep.

A tunable, high-accelerating-gradient cavity prototype has been designed and built for use in the rf system for the Low Energy Booster (LEB) at the Superconducting Super Collider (SSC). Testing of the cavity using one tuner cooling variant has been completed. This paper reports on results of low level, high level and tuning tests performed on the cavity. The tuner damaged during high power testing. Discussion of the is included.

27136 (SSCL-Preprint–357) **Collider bypass diode thermal simulations and measurements for the SSCL.** Rostamzadeh, C.; Tool, G. Superconducting Super Collider Lab., Dallas, TX (United States). May 1993. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930511–38: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014255. Source: OSTI; NTIS; INIS; GPO Dep.

Warm bypass diodes will be used as a component of a quench protection system to bypass an exponentially decaying current of 36 sec. time constant and peak current of 7000 A. Temperature excursions due to approximately 252 Kilo Ampere Sec. are studied using ANSYS, a finite element analysis program. A parabolic current waveform of similar energy but higher MIITs (1058 MIIT) was applied to the bypass circuit and temperature excursion was measured at various locations. The procedure of current waveform generation and thermal measurements is illustrated in this paper. A comparison of simulation technique with actual measurements confirms the accuracy of the bypass diode assembly model. This assembly is installed at the SSC half-cell string test facility and results are extremely encouraging.

27137 (SSCL-Preprint–359) **Accelerator Readiness Review process for the SSC Linac.** Tooker, J.F.; Benke, T.; Funk, L.W.; Oliphant, V. Superconducting Super Collider Lab., Dallas, TX (United States). May 1993. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930511–118: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014261. Source: OSTI; NTIS; INIS; GPO Dep.

As each accelerator of the SSCL is prepared for operation, it must have an Accelerator Readiness Review (ARR) in order to begin high power RF or beam operation. This review validates the Safety Analysis Report (SAR) and demonstrates to an independent review panel that (1) the systems and equipment are in place and have been fully tested with satisfactory results; (2) systems and equipment are covered as necessary by written procedures that

have been reviewed and approved; (3) those who carry out the activity are fully trained and qualified. The panel will then request that the SSCL Director give permission for operation. The Department of Energy must concur for operation to commence. The SSC Linac, a series of four accelerators, will be tested and commissioned in the Linac Tunnel in series starting in the fall of 1992 and ending in the spring of 1995. The Accelerator Readiness Review process will be described as it relates to the SSC Linac in order to support the staged commissioning.

27138 (SSCL-Preprint–360) **Preliminary testing of the LEB to MEB transfer kicker modulator prototype.** Pappas, G.C.; Askew, D.R. Superconducting Super Collider Lab., Dallas, TX (United States). May 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930511–57: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014061. Source: OSTI; NTIS; INIS; GPO Dep.

The extraction kicker for the Low Energy Booster (LEB) is used to deflect a 12 GeV/c proton beam from the synchrotron into a transfer line. A kicker system of similar design is used to inject the beam from the transfer line into the Medium Energy Booster (MEB). The modulator requirements for these kicker systems are to deliver a pulse train of seven 1.6kA, 2.5 μs pulses at a pulse repetition frequency of 20 pps, every seven seconds for one hour. The impedance of the modulator is 12.5 ω, resulting in a charge voltage of 40 kV. The 10–90% rise time of the pulses is 20 ns, and the 1–99% fall time is 2 μs. The allowable pulse ripple is $\pm$1% of the peak current during the pulse, and $\pm$0.3% from pulse to pulse. The shot -to-shot timing jitter requirement is less than ns. This paper describes the design and performance of the prototype modulator which was fabricated to meet these specifications.

27139 (SSCL-Preprint–362) **A digital approach for phase measurement applied to delta-t tuneup procedure.** Aiello, G. Superconducting Super Collider Lab., Dallas, TX (United States). May 1993. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930511–39: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014272. Source: OSTI; NTIS; INIS; GPO Dep.

Beam energy and phase in a Linac are important parameters to be measured in order to tune the machine. They can be calculated by the time of flight of a beam bunch over a known distance between two locations, and by comparing the phase of a cavity to the beam phase. The phase difference between two signals must be measured in both cases, in order to get the information required. The electronics to be used for this measurement must meet stringent requirements: high bandwidth, good accuracy and resolutim have always been a challenge for classical analog solutions. A digital approach has been investigated, which provides a good resolution, accuracy independent on the phase difference value, good repeatability and reliability. Numerical analysis have been performed, showing the system's optimal performance and limitations. A prototype has been tested in the laboratory, which confirm the predicted performance, and proves the system's feasibility.

27140 (SSCL-Preprint–364) **RF systems engineering for the SSC collider rings.** Schaffer, G.; Coleman, P.; Mustaine, R.; Wallace, J.; Wang, X.; Zhao, Y.; Rogers, J. Superconducting Super Collider Lab., Dallas, TX (United States). May 1993. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930511–31: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014181. Source: OSTI; NTIS; INIS; GPO Dep.

Acceleration and storage of 70-mA proton beams in the 2 $\times$ 20 TeV Supercollider rings can be performed both with normalconducting as well as superconducting 360-MHz rf systems. A normalconducting accelerating structure would use 32 or 24 single-cell cavities per ring, operating with a mean gradient of 2–2.6 MV/m to generate the required peak voltage of 20 MV in the beam holding mode. Superconducting cavities would allow operation with mean gradients UP to about 5 MV/m, and tolerate higher transient beam loading due to nearly tenfold larger stored energy in the accelerating structure. A superconducting structure could consist of five pairs of single-cell resonators per ring, each pair being fed by a 250kW cw klystron amplifier. The use of 500-kW or 250-kW klystron amplifiers, six or eight per ring, would seem appropriate for feeding normalconducting structures. Provisions for feedforward and feedback(rf amplitude and phase) are included in the low-level rf system. Furthermore, active damping of undesired modes and corrections of bunch phase deviations are planned by means of auxiliary (broadband) rf systems.

27141 (SSCL-Preprint–374) **Bunch Shape Monitor for SSCL linac.** Hurd, J.W. (Superconducting Super Collider Lab., Dallas, TX (United States)); Arbique, G.M.; Crist, C.E.; Guy, F.W.; Leifeste, G.T.; Raparia, D.; Saadatmand, K.; Swenson, D.A.; Esin, S.; Feschenko, A.; Stepanov, A.; Mirzojan, A. Superconducting Super Collider Lab., Dallas, TX (United States). May 1993. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930511–58: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014060. Source: OSTI; NTIS; INIS; GPO Dep.

The Superconducting Super Collider Laboratory and the Institute for Nuclear Research ore collaboratively developing a Bunch Shape Monitor diagnostics for commission the SSCL linac. The Bunch Shape Monitor is designed to measure the intensity of beam as a function of time over the micro-bunch of the beam. Design resolution for the SSCL monitors is approximately 7 psec. The first monitor will operate at the fundamental frequency of 428 MHz and will be used to measure the output beam of the RFQ Linac. First available results will be presented and compared with predictions. Further development will allow the monitors to fit in a standard SSCL beam box and one will operate at the third harmonic of 428 MHz. Proposals to use the Bunch Shape Monitor to measure the longitudinal phase space distribution of the beam will be discussed.

27142 (SSCL-Preprint–380) **RF cavity for the Medium Energy Booster (MEB) for SSCL.** Yakoviev, V.P. (Budker Inst. of Nuclear Physics (Russian Federation)); Petrov, V.M.; Kwiatkowski, S.; Curbow, J.; Enegren, T.; Propp, A. Superconducting Super Collider Lab., Dallas, TX (United States). May 1993. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930511–60: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014064. Source: OSTI; NTIS; INIS; GPO Dep.

The RF cavity for the Medium Energy Booster (MEB) is required to accept beam from the low energy booster (LEB) at a momentum of 12 GeV/c (possibly 10 GeV/c) and accelerate it to 200 GeV/c. Each cavity must provide a maximum gap voltage of 250 kV, and must be tunable from 59.7 MHz to 59.96 MHz with a maximum sweep rate of 450 kHz/s. This requires a ferrite-tuned cavity with a high quality factor. A quarter-wave cavity was designed which meets these requirements while minimizing beam-loading problems (minimizes R/Q). This paper describes the design of this cavity, results from measurements of a corresponding cold model, and several proposed Higher Order Mode (HOM) damping system designs.

27143 (SSCL-Preprint–381) **The SSC RFQ-DTL matching section buncher cavities.** Enegren, T.; Combs, C.M.; Goren, Y.; Hayworth, M.D.; Ringwall, A.D.; Swenson, D.A. Superconducting Super Collider Lab., Dallas, TX (United States). May 1993. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930511–59: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014065. Source: OSTI; NTIS; INIS; GPO Dep.

The RFQ-DTL matching section of the SSCL Linear Accelerator matches the 2.5 MeV H^- beam from the RFQ into the acceptance of the 70 MeV Drift Tube Linac (DTL). To provide longitudinal phase space tuning, two rf buncher cavities with a resonant frequency of 427.617 MHz and with a maximum E_0TL of 160 kV are required. To meet the limited space requirements, it was decided to use double gap buncher cavities.

27144 (SSCL-Preprint–383) **Mechanical integration of an RF volume source and einzel lens LEBT to the SSC RFQ.** Valicenti, R.A.; Lenz, J.; Okay, N.C.; Plesea, L.; Saadatmand, K. Superconducting Super Collider Lab., Dallas, TX (United States). May 1993. 4p. Sponsored by USDOE, Washington, DC (United States). DOE

Contract AC35-89ER40486. (CONF-930511–130: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014263. Source: OSTI; NTIS; INIS; GPO Dep.

The Superconducting Super Collider (SSC) LINAC Injector is currently operating with an RF-driven volume ion source coupled with an einzel lens Low Energy Beam Transport (LEBT). The ion source, LEBT and beam diagnostics are integrated into a compact vacuum enclosure which is mounted to the ups endwall of the Radio Frequency Quadrupole (RFQ). Beam dynamic requirements imposed a minimum longitudinal of only 23.5 cm, thus creating a very challenging packaging problem. In addition, optimum beam matching to the RFQ specified a maximum gap of 1 cm between the LEBT and the entrance endwall face, thereby excluding the use of a bellows between the LEBT chamber and the RFQ. Vacuum system induced loads and vibrations are isolated from the beamline components by the use of a straddling frame which is an integral component of the vacuum system/support cart TWs paper will desirable some of the unique aspects of the mechanical design resulting from beam requirements, high gas load, availability of the vacuum system and the need for unconstrained attachment to the RFQ. In addition, the mobile installation cart and the fully automated vacuum control system will be discussed.

27145 (SSCL-Preprint–398) **The SSCL RFQ system integration.** Arbique, G.; Calo, A.; Cuevas, C.; Datte, P.; Evans, D.; Hurd, J.; Marsden, E.; Saadatmand, K.; Sage, J. Superconducting Super Collider Lab., Dallas, TX (United States). May 1993. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930511–184: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93016103. Source: OSTI; NTIS; INIS; GPO Dep.

The integration and performance of subsystems on the Superconducting Super Collider Laboratory (SSCL) 428 MHz, 0.1% duty factor radiofrequency quadrupole accelerator is reported. Results of low- and high-power rf measurements on the RFQ cavity are compared to design specifications. Operation of the integrated RFQ vacuum, temperature and supervisory control systems are described.

27146 (SSCL-Preprint–400) **Computer simulation and cold model testing of CCL cavities.** Chang, C.R.; Yao, C.G.; Swenson, D.A.; Funk, L.W. Superconducting Super Collider Lab., Dallas, TX (United States). May 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930511–183: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93016105. Source: OSTI; NTIS; INIS; GPO Dep.

The SSC coupled-cavity-linac (CCL) consists of nine modules with eight tanks in each module. Multicavity magnetically coupled bridge couplers are used to couple the eight tanks within a module into one RF resonant chain. The operating frequency is 1282.851 MHz. In this paper we discuss both computer calculations and cold model measurements to determine the geometry dimension of the RF structure.

27147 (SSCL-Preprint–414) **Issues of the transverse feedback systems design at the SSC.** Chou, W.; Peterson, J. Superconducting Super Collider Lab., Dallas, TX (United States). May 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930511–180: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93015902. Source: OSTI; NTIS; INIS; GPO Dep.

The transverse feedback systems are needed at the SSC for several different reasons. The requirements of these systems are analyzed and specified. In addition to the general requirements (power, bandwidth and gain), specific attention is given to the noises in the systems, which need to be controlled in order to keep the emittance growth at a tolerable rate. A quantitative treatment is given to specify the allowable noise level in the feedback systems.

27148 (UCRL-JC–109740) **SNOELF: An FEL-based drive beam injector for CLIC.** Barletta, W.A. (Lawrence Livermore National Lab., CA (United States)); Bonifacio, R. Lawrence Livermore National Lab., CA (United States). Jul 1992. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-920706–53: International conference on high energy accelerators, Hamburg (Germany), 20-24 Jul 1992). Order Number DE93012574. Source: OSTI; NTIS; GPO Dep.

We describe a means of producing at train of 40kA pulses of 3 ps duration as the drive beam for CLIC using an amalgam of magnetic switching technology plus a rf-linac driven free electron laser (FEL) buncher. Potential debunching effects are discussed. Finally we describe a low energy test experiment.

27149 (UCRL-JC–110198) **Status of the Choppertron experiments.** Houck, T.L.; Westenskow, G.A. Lawrence Livermore National Lab., CA (United States). Aug 1992. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9208109–83: 16. international LINAC conference, Ottawa (Canada), 23-28 Aug 1992). Order Number DE93013428. Source: OSTI; NTIS; INIS; GPO Dep.

The Choppertron is a high-power, 11.4-GHz microwave generator driven by a linear induction accelerator (LIA). Earlier work with the Chopperton using a 2.5-MV, 1-kA beam demonstrated both high power and quality (phase and amplitude stability) microwave pulses. Significant effort was expended on suppressing pulse shortening caused by excitation of higher order modes. A new series of experiments are coming on-line using a 5-MV, 1-kA LIA beam to drive an upgraded Choppertron. In this paper we review the performance of the Choppertron at 2.5 MV including observed pulse shortening and describe the current status of the experiments. We discuss proposed experiments including reacceleration, active phase stabilization, and high-power microwave extraction.

27150 (UCRL-JC–110200) **Computation of wakefields in structures containing dispersive materials.** DeFord, J.F. (Lawrence Livermore National Lab., CA (United States)); Craig, G.D.; Kamin, G.; Walling, L. Lawrence Livermore National Lab., CA (United States). 21 Aug 1992. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9208109–85: 16. international LINAC conference, Ottawa (Canada), 23-28 Aug 1992). Order Number DE93013418. Source: OSTI; NTIS; INIS; GPO Dep.

Ferrite has a variety of applications in accelerator components, and the capability to model this magnetic material in the time domain is an important adjunct to currently available accelerator modeling tools. In this paper is described a general dispersive material model which is suitable for a wide variety of media, including ferrite. Based on this model we have developed a representation of the time-domain magnetic properties of PE11BL, the ferrite used in the induction modules of the ETA-II (Experimental Test Accelerator - II) induction linac at LLNL. This material is characteristic of the soft ferrites commonly used in induction accelerators. The model has been implemented in I-D and 2-D finite-difference time-domain (FDTD) electromagnetic simulators, and comparisons with analytic and experimental results are presented.

27151 (UCRL-JC–112343) **One dimensional simulations of transients in heavy ion injectors.** Barnard, J.J. (Lawrence Livermore National Lab., CA (US)); Caporaso, G.J.; Yu, S.S.; Eylon, E. Lawrence Livermore National Lab., CA (United States); Lawrence Berkeley Lab., CA (United States). 11 May 1993. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48 ;AC03-76SF00098. (CONF-930511–214: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93016547. Source: OSTI; NTIS; INIS; GPO Dep.

A fast-running time-dependent one-dimensional particle code has been developed to simulate transients in both electrostatic quadrupole and electrostatic column heavy-ion injectors. Two-dimensional effects are incorporated through the use of an approximation to the transverse part of the Laplacian operator. Longitudinal electric fields are solved on a mesh. An external circuit is coupled to the column, and the effect of the beam on the circuit is modeled. Transients such as initial current spikes, space-charge de-bunching, and beam loading of the circuit, are simulated. Future directions for the code include introduction of envelope and centroid equations to provide beam radius and displacement information and the modeling of secondary electron currents arising from beam-spill.

27152 (UCRL-JC–114215) **Reacceleration experiment to demonstrate the concept of efficiency enhancement in a relativistic klystron two-beam accelerator.** Westenskow, G.A.; Houck, T.L. Lawrence Livermore National Lab., CA (United States). May 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-930511–8: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93013856. Source: OSTI; NTIS; INIS; GPO Dep.

High conversion efficiency of electro beam energy to rf energy can be achieved in two-beam accelerators using reacceleration of the bunched drive beam. To study issues with these designs we are planning a demonstration in which a modulated beam's energy is boosted as it passes through induction accelerator cells. For this experiment we will use the front end of the Choppertron to modulate a 5 MeV electron beam at 11.4 GHz. We have now tested the 5-MeV Choppertron and are reporting on the results. For the reacceleration experiment we plan to use three stages of rf power extraction interspersed with two stages of reacceleration.

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Refer also to citation(s) 27006, 27014, 27077, 27083, 27086, 27089, 27090, 28139

27153 (BNL–48217) **Development of distributed ion pumps for g-2 beam vacuum system.** Hseuh, H.C.; Mapes, M.; Snydstrup, L. Brookhaven National Lab., Upton, NY (United States). [1993]. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-930511–151: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93015404. Source: OSTI; NTIS; INIS; GPO Dep.

Distributed ion pumps (DIPs) will be used for the beam vacuum system of the g-2 muon storage ring. The magnetic field intensity and alignment angle at the DIP locations are not uniform. The pumping behavior of several different ion pump elements under this non-uniform magnetic field has been studied. The results are compared with the theoretical predictions. Based on these results, the optimum design of the g-2 DIPs has been developed.

27154 (BNL–48271) **A simulation study of linear coupling effects and their correction in RHIC.** Parzen, G. Brookhaven National Lab., Upton, NY (United States). [1993]. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-930511–150: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93015403. Source: OSTI; NTIS; INIS; GPO Dep.

This paper describes a possible skew quadrupole correction system for linear coupling effects for the RHIC92 lattice. A simulation study has been done for this correction system. Results are given for the performance of the correction system and the required strength of the skew quadrupole corrections. The location of the correctors is discussed. For RHIC92, it appears possible to use the same 2 family correction system for all the likely choices of β^*. The simulation study gives results for the residual tune splitting that remains after correction with a 2 family correction system. It also gives results for the beta functions before and after correction.

27155 (BNL–48367) **Desorption measurements of copper and copper alloys for PEP-II.** Foerster, C.L. (Brookhaven National Lab., Upton, NY (United States)); Halama, H.; Korn, G.; Calderon, M.; Barletta, W. Brookhaven National Lab., Upton, NY (United States). [1992]. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-9210161–5: 12. international vacuum congress; 8. international conference on solid surfaces, Hague (Netherlands); Hague (Netherlands), 12-16 Oct 1992; 12-16 oct 1992; CONF-9210162–4). Order Number DE93015398. Source: OSTI; NTIS; INIS; GPO Dep.

PEP-II will be a meson factory circulating asymmetric beams of 9 GeV and 3.1 GeV having maximum currents of 3.0A. Copper beam chambers and absorbers will intercept resulting synchrotron radiation and it is critical that the dynamic gas load from photo stimulated desorption (PSD) and thermal outgassing is below 2×10^{-1} molecules per photon. An experiment was set up to measure PSD from 1m long bar samples and a chamber sample, fabricated from selected copper and copper alloys then exposed to white light with a critical energy of 500 eV, on beamline U10B at the VUV ring of the National Synchrotron Light Source (NSLS). Based on U10B results a prototype chamber was built and will be exposed to white light with higher critical energies of up to 5 KeV, on beamline X-28A at the X-ray Ring of the NSLS. This paper presents the measurements of H_2, CO, CO_2 and CH_4 desorption yields as function of accumulated photon flux, angle of incidence, sample material, and surface condition. The results are compared with that of previous work on similar materials and with that of others for copper.

27156 (IFVE-OP–91-123) **Errors in beam channels and their correction.** Garkusha, V.I.; Kartashev, V.P.; Kotov, V.I.; Novgorodov, A.L.; Novoskol'tsev, F.N. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov (Russian Federation). Inst. Fiziki Vysokikh Ehnergij. 1991. [13p.] (In Russian). Order Number DE93629654. Source: OSTI; NTIS (US Sales Only); INIS.

Error alignment-effecting of the beam magnet elements (with taking into account the geodesic procedures of installation) and their regimes to beam characteristics are considered. The obtained expressions allow to estimate the changing ranges of beam parameters and choose the optimum correction systems of optic axis and beam envelope during the beams design stage. The results are illustrated on example of transport of UNK proton beam extracted from accelerator. 4 refs.; 5 figs.

27157 (IFVE-OUNK–91-178) **Methods of UNK SC-dipoles magnetic measurements.** Smirnov, N.L. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov (Russian Federation). Inst. Fiziki Vysokikh Ehnergij. 1991. [16p.] (In Russian). (CONF-9106433–: 7. International Magnetic Measurement Workshop (IMMW-7), Darmstadt (Germany), 18-21 Jun 1991). Order Number DE93628272. Source: OSTI; NTIS (US Sales Only); INIS.

Presented at the 7th International meeting on magnetic dimensions, Darmstadt (Germany), 18-21 June 1991.

Many SC-dipoles for UNK will require from the chosen magnetic measurement methods high accuracy and efficiency. The brief of using methods, their possibilities and analysis of their errors are given. The measurements results for a full-scale model of SC-dipole SPDM1 are presented. 5 refs.; 4 figs.; 3 tabs.

27158 (IYaF–91-120) **Suppression of emittance growth caused by mechanical vibrations of magnetic elements in presence of beam-beam effects in the SSC.** Lebedev, V.A.; Parkhomchuk, V.V.; Shil'tsev, V.D.; Skrinskij, A.N. AN SSSR, Novosibirsk (Russian Federation). Inst. Yadernoj Fiziki. 1991. [51p.] Order Number DE93629655. Source: OSTI; NTIS (US Sales Only); INIS.

A ground motion produces shifts of storage ring quadrupoles. It strongly influences on the beam behaviour in large proton (anti)proton colliders due to the closed orbit distortion and due to the transverse emittance growth. Calculations of both effects are presented in this paper. An active feedback system is useful for the emittance growth suppression. It is shown that in this case the main parameter which determines the emittance growth is the betatron tune spread due to the beam-beam effects. A simple analytical model is considered which results are in good coincidence with computer simulations. All calculations are adapted to the Superconducting Super Collider (SSC). 13 refs.; 9 figs.; 3 tabs.

27159 (JAERI-M–93-021) **Calculations of thermal deformations in directly water-cooled monochromator crystals.** Matsuki, Nobuo (JAERI-RIKEN SPring-8 Project Team, Tokyo (Japan)); Hashimoto, Shinya; Motohashi, Haruhiko. Japan Atomic Energy Research Inst., Tokyo (Japan). Feb 1993. 26p. (In Japanese). Order Number DE93508284. Source: OSTI; NTIS; INIS.

Computer simulations on the thermal behaviors, i.e., thermal transfer coefficient, temperature distribution and thermal deformations of monochromator crystals have been reported under the condition that they would be used in SPring-8. The calculations have been carried out on the basis of high heat load experiments by the present authors with a finite element analysis code (ANSYS). The bending-magnet (with power density of 0.27 MW/m^2 on crystal surface) causes a temperature rise of 4 K and a slope error

of 0.27 arcsec on the top surface of crystal. On the prototype X-ray undulator WPH-33J beamline, the crystal receives a power density of 8.1 MW/m^2, having a temperature rise of 85 K and a slope error of 2.1 arcsec in the simulation. (author).

27160 (JAERI-M–93-030) **Simulation of electron-positron convertor for SPring-8.** Mizuno, Akihiko (JAERI-RIKEN SPring-8 Project Team, Tokyo (Japan)); Suzuki, Shinsuke; Yoshikawa, Hiroshi; Hori, Toshihiko; Yanagida, Kenichi; Yokomizo, Hideaki. Japan Atomic Energy Research Inst., Tokyo (Japan). Mar 1993. 46p. (In Japanese). Order Number DE93508313. Source: OSTI; NTIS; INIS.

In the SPring-8, we are planning to use positrons in order to increase the beam life time in a storage-ring. These positrons are producted at a electron-positron convertor in a linac. In this report, we presented simulations about conversion efficiency of the convertor with various magnetic fields of the convertor system. We constructed the test apparatus of convertor in Tokai establishment, JAERI. But in this report, we also simulated with the conditions which are not available in the apparatus, so as to cover the results of experiments. And we found the best constitution of magnetic fields for the convertor. The conversion efficiency is up to 0.27% with the best magnetic fields. The aim of this report is to help designing the positron-electron convertor of the SPring-8 linac. (author).

27161 (JAERI-M–93-051) **Basic study on vacuum system of an electron synchrotron and mock-up tests.** Ohtsuka, Hideo (JAERI-RIKEN SPring-8 Project Team, Tokyo (Japan)); Yoneyama, Shoji; Shimada, Taihei. Japan Atomic Energy Research Inst., Tokyo (Japan). Mar 1993. 43p. (In Japanese). Order Number DE93508316. Source: OSTI; NTIS; INIS.

Simple methods which are intended for the vacuum system of an electron synchrotron are applied to the fundamental design study. Those subjects are beam life time as a function of the vacuum pressure, the pressure distribution in the duct, heat problem due to synchrotron radiation, stray magnetic fields due to eddy currents and others. Mock-up tests of the vacuum system have been also made. Data base which can be utilized at the design work has been obtained. Furthermore, good agreements between the simple analyses and the experimental results are shown. (author).

27162 (KEK–92-20) **Report of the design study on a high brilliance configuration of the PF storage ring.** Katoh, M.; Hori, Y. (eds.). National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Feb 1993. 191p. (In Japanese). Order Number DE93508335. Source: OSTI; NTIS; INIS.

The 2.5 GeV Photon Factory storage ring has been steadily improved by decade-long research and development. Its performance, especially the stored current, beam lifetime and beam stability, has been achieved to the world highest level. As one of our recent activities, a high brilliance configuration was proposed. In the new configuration, the focussing magnet of the normal cells will be reinforced. Every light source position and direction of beamline will not be changed since all bending magnets keep their present locations. The beam emittance will be reduced to 27 nmrad which is one fifth of the present value (130 nmrad). The brilliance will be increased typically by a factor of 10. In this report, we describe the high brilliance ring configuration as well as the procedure and time schedule in the possible reconstruction. (author).

27163 (LA-UR–93-1868) **First-turn losses in the LAMPF Proton Storage Ring (PSR).** Hutson, R.; Macek, R. Los Alamos National Lab., NM (United States). [1993]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930511–111: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014477. Source: OSTI; NTIS; INIS; GPO Dep.

Beam-loss measurements protons injected into the PSR are lost during the first turn. We describe a plausible mechanism, involving field stripping of excited hydrogen atoms, for these losses. Protons are injected into the PSR by transporting a neutral hydrogen beam through a hole in the yoke of one ring bender and then through a carbon foil on the ring axis. The foil strips roughly 93% of the beam atoms to protons. Although the original PSR design assumed that all unstripped atoms would pass through a hole in the yoke of the next downstream bender and on to a beam stop, recent calculations indicate that about 6% of these unstripped atoms will emerge from the foil in an excited state with principle quantum number $n \geq 23$. These calculations also indicate that atoms in excited states with $n \geq 3$ will be stripped quickly to protons in the 1.2-Tesla field of the downstream bender. The trajectories of these protons will be outside the phase-space acceptance of the ring and will be quickly lost by collision with the beam pipe, thereby giving rise to first-turn losses. The estimated numbers of protons that would be lost by this mechanism are consistent with the observed first-turn loss rates. This mechanism has important consequences for the design of future storage rings that use neutral atom or negative ion stripping for injection.

27164 (LA-UR–93-1874) **Recent study of beam stability in the PSR.** Wang, T.S.F. (Los Alamos National Lab., NM (United States)); Cooper, R.; Fitzgerald, D.; Frankle, S.; Hardek, T.; Hutson, R.; Macek, R.; Ohmori, C.; Plum, M.; Thiessen, H.; Wilkinson, C.; Colton, E.; Neuffer, D.; Rees, G. Los Alamos National Lab., NM (United States). [1993]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930511–112: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014473. Source: OSTI; NTIS; INIS; GPO Dep.

A fast transverse instability with beam loss has been observed in the 800 MeV Los Alamos Pro Ring (PSR) when the injected beam intensity reaches 2 - 4 $\times$ 10^{13} protons per pulse. Previous observations in that the instability is most likely driven by electrons trapped within the proton beam. Theoretical study shown that beam leakage into the inter-bunch gap leads to electron trapping. Recent experiments were carried out by using the newly implemented "pinger" and by varying the machine transition gamma to explore further the "e-p" instability and the nature of the instability. This paper summarizes some of these recent experimental results and theoretical studies.

27165 (LA-UR–93-1921) **Beam pinging, sweeping, shaking, and electron/ion collecting, at the Proton Storage Ring.** Hardek, T.W.; Macek, R.J.; Plum, M.A.; Wang, T.S.F. Los Alamos National Lab., NM (United States). [1993]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930511–114: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014457. Source: OSTI; NTIS; INIS; GPO Dep.

We have built, installed and tested a pinger for use as a general diagnostic at the Los Alamos Proton Storage Ring (PSR). Two 4-m-long parallel-plate electrodes with a plate spacing of 10.2 cm provide kicks of up to 1.1 mrad. A pair of solid-state pulsers may be operated in a single-pulse mode for beam pinging (tune measurements) or in a burst mode at up to 700 kHz pulse rates for beam sweeping. During our 1992 operating period we used the pinger for beam sweeping, for beam shaking, for measuring the tune shift, and we have used it as an ion chamber. Using the pinger as an ion chamber during production conditions has yielded some surprising results.

27166 (LBL–33307) **Design of the Advanced Light Source timing system.** Fahmie, M. Lawrence Berkeley Lab., CA (United States). May 1993. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-930511–157: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93015042. Source: OSTI; NTIS; INIS; GPO Dep.

The Advanced Light Source (ALS) is a third generation synchrotron radiation facility, and as such, has several unique timing requirements. Arbitrary Storage Ring filling patterns and high single bunch purity requirements demand a highly stable, low jitter timing system with the flexibility to reconfigure on a pulse-to-pulse basis. This modular system utilizes a highly linear Gauss Clock with "on the fly" programmable setpoints to track a free-running Booster ramping magnet and provides digitally programmable sequencing and delay for Electron Gun, Linac, Booster Ring, and Storage Ring RF, Pulsed Magnet, and Instrumentation systems. It has proven itself over the last year of accelerator operation to be reliable and rock solid.

27167 (SLAC-PUB–6035) **Bunch-by-bunch feedback for PEP II.** Oxoby, G. (Stanford Linear Accelerator Center, Menlo Park, CA (United States)); Claus, R.; Eisen, N.; Fox, J.; Hindi, H.; Hoeflich, J.; Olsen, J.; Sapozhnikov, L.; Linscott, I. Stanford Linear Accelerator Center, Menlo Park, CA (United States). Jan 1993. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00515. (CONF-9211172–6: International workshop on B factories: accelerators and experiments, Tsukuba (Japan), 17-20 Nov 1992). Order Number DE93015598. Source: OSTI; NTIS; INIS; GPO Dep.

The proposed PEP II B factory at SLAC requires a feedback to damp out longitudinal synchrotron oscillations. A time domain, downsampled, bunch-by-bunch feedback system in which each bunch is treated as an oscillator being driven by disturbances from other bunches is presented as we review the evolution of the system design. Results from a synchrotron oscillation damping experiment conducted at the SLAC/SSRL/SPEAR ring are also presented in this paper.

27168 (UCRL-JC–112334) **Distributed ion pump testing for PEP II, asymmetric B-Factory collider.** Calderon, M. (Lawrence Livermore National Lab., CA (United States)); Holdener, F.; Barletta, W.; Petersen, D.; Foerster, C. Lawrence Livermore National Lab., CA (United States). 12 May 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-930511–133: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93015102. Source: OSTI; NTIS; INIS; GPO Dep.

At its design level, PEP-II will circulate asymmetric beams at 9 GeV and 1.5 A in a High Energy Ring and 3.1 GeV with 2.1 A in a Low Energy Ring. In addition, the vacuum systems of both rings will be designed to operate at a maximum current of 3 A to provide for higher current operation in the future. Pumping for both rings is provided by sputter ion pump systems. In the High Energy Ring, high gas loads, deriving from the intense photon radiation, are calculated at 1.06 x 10^{-6} Torr liters s^{-1} m^{-1} using a desorption coefficient (eta) of 2 x 10^{-6} molecules $photon^{-1}$. To maintain an average pressure of 5 nTorr or less in the arc cells, lumped ion pumps are used in the 2 m long straight sections and distributed ion pumps are used in the 6 m long dipole chambers where the conductance of the vacuum chamber is prohibitively low. To achieve these pressures, the distributed ion pump system is required to have pumping speeds of 110 liters s^{-1} m^{-1} however, a design level of 165 liters s^{-1} m^{-1} has been set to provide a factor of safety of 50% based on pumping alone.

44 INSTRUMENTATION

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Refer also to citation(s) 25641, 25650, 25876, 25888, 25894, 26567, 26775, 26792, 27097, 27132, 27235, 27241, 27302, 27303, 27304, 27310, 27436, 27525, 27632, 27701, 27713, 27770, 27773, 27779, 27809, 27830, 27832, 28136

27169 (ANL-HEP-TR–93-36) **Measurement of source tube radial position in cast EMC testbeam module.** Jankowski, D.; Stanek, R. Argonne National Lab., IL (United States). High Energy Physics Div. 5 May 1993. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (SDC–93-499). Order Number DE93015145. Source: OSTI; NTIS; INIS; GPO Dep.

Using a ^{137}Cs source we have determined the position of two of the source tubes embedded in the Pb absorber in the cast EMC module used in the Fermilab test beam. Two scintillator tiles placed in the gaps on both sides of an absorber containing a source tube were readout into independent phototubes. The difference in scintillator response was measured in two towers at two different source tube layers. We find the source tube to be displaced towards the (radial) front of the EMC by about 1.6 mm in both measurements. Work is proceeding now to check other source tubes in other locations.

27170 (BNL–48807) **Evaluation of an x-ray fluorimeter for measuring lead in paint.** Klein, R.C.; Horn, F.T.; Wilson, R.D. Brookhaven National Lab., Upton, NY (United States). 17 Mar 1993. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. Order Number DE93014316. Source: OSTI; NTIS; GPO Dep.

A laboratory analysis of key performance features of the Warrington Microlead I XRF Analyzer was conducted. This analysis included the determination of instrument accuracy and precision as measured against standard reference materials as well as the instrument's ability to provide information for multiple layers of a lead-based paint.

27171 (BNL–48960) **Crystallographic and metallurgical characterization of radiation detector grade cadmium telluride materials.** Johnson, C.J. (II-VI, Inc., Saxonburg, PA (United States). eV Products Div.); Eissler, E.E.; Cameron, S.E.; Kong, Y.; Fan, S.; Jovanovic, S.; Lynn, K.G. Brookhaven National Lab., Upton, NY (United States). [1993]. 30p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-930405–11: Spring meeting of the Materials Research Society, San Francisco, CA (United States), 12-16 Apr 1993). Order Number DE93014335. Source: OSTI; NTIS; GPO Dep.

Radiation detector grade CdTe crystals are characterized by several crystallographic and metallurgical techniques including infrared microscopy, dislocation etch pitting and X-ray diffraction. Results are presented for a set of 50 detectors fabricated from an ingot produced by the High Pressure Bridgman method. Data on the temperature dependence of leakage current and pulse height analysis are presented, along with measurements of room temperature charge transport properties. Attempts to relate crystal structure to detector performance discussed.

27172 (CEA-LNS-GT–92-06) **Analysis of ^3He from $p+d \rightarrow {}^3He+\eta$ by a combination of solenoid and spectrometer.** Doornbos, J. Laboratoire National Saturne - Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). 1992. [24p.] Order Number DE93631539. Source: OSTI; NTIS (US Sales Only); INIS.

The ETA Collaboration aims to measure the decay $\eta \rightarrow \mu^+, \mu^-, \pi^0$. The η particles are produced in the reaction $P+D \rightarrow {}^3He+\eta$ at a proton energy of 896 MeV just above the η production threshold. The ^3He momentum is 1,320 MeV/c, which is 660 MeV/c per unit of charge. The two muons are analyzed in a muon spectrometer. These decay products are tagged with the ^3He which are analyzed in a separate spectrometer, the SATURNE spectrometer SPES2. The results of an investigation of the optics of the ^3He are given, in this combined system of solenoid and spectrometer. (R.P.) 2 refs.; 16 figs.

27173 (CEA-R–5624) **Adjustment of a goniometer for X-rays optics calibration in the spectral range 1.5-20 KeV.** Legistre, S. Conservatoire National des Arts et Metiers (CNAM), 75 - Paris (France); CEA Centre d'Etudes de Bruyeres-le-Chatel, 91 (France). Oct 1992. [98p.] (In French). Order Number DE93631550. Source: OSTI; NTIS (US Sales Only); INIS.

The aim of this memoir is the adjustment of a (θ, 2θ) goniometer coupled to X-rays source to calibrate mirrors (single layers like C, Ni, Au, etc... and multilayers like C/W, Si/W, etc...) in the spectral range 1.5 - 20 keV. For each kind of tested optics the adjustment of the goniometer include the procedure alignment of the different components (X-ray source, collimation slits, optics, detectors) and the first reflectivity measurements. Those measurements are compared those realized at LURE, using synchrotron radiation provided by SUPER ACO storage ring, and to a theoretical simulation.

27174 (CONF-9209263–13) **Signal processing for liquid ionization calorimeters.** Cleland, W.E.; Stern, E.G. Pittsburgh Univ., PA (United States). Dept. of Physics and Astronomy. [1992]. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-91ER40646 ;AC02-80ER10667. From 3. international conference on calorimetry in high energy physics; Corpus Christi, TX (United States); 29 Sep - 2 oct 1992. Order Number DE93013490. Source: OSTI; NTIS; INIS; GPO Dep.

We present the results of a study of the effects of thermal and pileup noise in liquid ionization calorimeters operating in a high luminosity calorimeters operating in a high luminosity environment.

The method of optimal filtering of multiply-sampled signals which may be used to improve the timing and amplitude resolution of calorimeter signals is described, and its implications for signal shaping functions are examined. The dependence of the time and amplitude resolution on the relative strength of the pileup and thermal noise, which varies with such parameters as luminosity, rapidity and calorimeter cell size, is examined.

27175 (CRN-CPR–90-06) **Temporal and spectral analysis of the synchronization of synchroscan streak cameras.** Cunin, B. (Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires); Geist, P.; Heisel, F.; Martz, A.; Miehe, J.A. Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires. 1990. [9p.] (CONF-9009248–: 19. international congress on high speed photography and photonics, Cambridge (United Kingdom), 16-22 Sep 1990). Order Number DE93631540. Source: OSTI; NTIS (US Sales Only); INIS.

A stochastic model has been developed to explain the well-known experimental results in synchroscan measurements with actively mode-locked lasers. It is demonstrated that, in the configuration where the synchronization is carried out by means of the ultrastable oscillator exciting the acousto-optic mode-locker of the laser, the overall temporal resolution is considerably lower than in the case where the deflection is performed by the electric signal directly derived from the optical recurrent pulses. The calculations including both random period fluctuations of the laser pulses and temporal jitter due to the electronic trigger system are corroborated by experimental investigations. The study shows that even in the presence of the phase noise in the laser beam, a jitter free synchronization can be achieved. (author) 8 refs.; 4 figs.

27176 (CRN-CPR–91-01) **Towards jitter free synchronization of synchroscan streak cameras by noisy periodic laser pulses.** Cunin, B. (Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires); Heisel, F.; Miehe, J.A. Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires. 1991. [18p.] Order Number DE93631541. Source: OSTI; NTIS (US Sales Only); INIS.

To be published in Optics Communications, 1991 v. 82(491).

In connection with the parameters characterizing the phase noise in cw mode-locked lasers and under the employ of streak cameras operated by sinewave deflection, the timing capabilities of the measuring system for two commonly used synchronization techniques are discussed by stochastic description. Especially, the power spectrum of the sweep signal versus the laser phase noise is examined in detail. The theoretical results are used to interpret experimental observations recorded by means of actively and passively mode-locked lasers. One of the interesting applications of synchroscan operations to metrology is the determination of short-term instabilities of the oscillator on a time scale near to the period. (author) 12 refs.; 3 figs.

27177 (CRN-CPR–91-02) **Stochastic analysis of synchroscan operations of a streak camera.** Cunin, B. (Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires); Heisel, F.; Miehe, J.A. Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires. 1991. [16p.] Order Number DE93631551. Source: OSTI; NTIS (US Sales Only); INIS.

To be published in Applied Physics B, 1991 v. 53(148).

A theoretical and experimental study of the picosecond synchronization of a streak camera used in conjunction with a cw actively mode-locked laser system is presented. The temporal resolutions of two synchronization set-ups, a passive device (the sweep is obtained directly from the modelocker oscillator) and an active arrangement (the deflection is derived from the recurrent laser pulses through a photodiode and a tunnel diode) have been examined. On the basis of the stochastic analysis it has been possible to interpret the experimental results for both configurations: particularly it has been demonstrated that even in the presence of phase noise in the laser signal, perfect synchronization can be achieved. (author) 13 refs.; 4 figs.

27178 (DOE/ER/40149–T1) **Studies of nuclei far from stability in the A=80 mass region: Final report.** Coldwell, R.L.; Dunnam, F.E.; Muga, M.L.; Rester, A.C. Florida Univ., Alachua, FL (United States). Inst. for Astrophysics and Planetary Exploration. [1990]. 30p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-84ER40149. Order Number DE93015732. Source: OSTI; NTIS; INIS; GPO Dep.

A three-stage thin-film detector for the identification of heavy ion fragments was investigated in beam at HHIRF. An experiment on Eu-152 for the purposes of calibrating a four-crystal Germanium polarimeter was performed. The instrument was then used in an experiment to establish polarities for the low-lying transitions in ^{82}Sr. The spectral fitting code ROBFIT was applied to the data analysis and shown to perform well on the extraction of weak peaks in high background situations.

27179 (DOE/FTR–93013020) **[Travel to China to evaluate facilities for the production of barium fluoride and other inorganic scintillating crystals used in high energy physics detectors]: Foreign trip report, July 1–16, 1992.** Wuest, C.R. Lawrence Livermore National Lab., CA (United States). 6 Aug 1992. 32p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93013020. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This trip involved meeting with groups of physicists and engineers on a daily basis for 12 days to see facilities in China that could be useful for the full-scale production of barium fluoride scintillating crystals for the GEM Detector to be built at the SSC. Meetings and tours were arranged by our Chinese hosts. Among the facilities visited were the optical coating facility at BGRI, the heavy machine shops and fine optics machining, polishing and coating facilities at ZOIF, and the crystal growing and machining shops at SICCAS, Jiading Plant. Briefings were given to the Chinese regarding the state of R&D at the SSC and within the Barium Fluoride Collaboration. Technical discussions included detailed descriptions of recent progress in China on the growing, machining, polishing and optical coating of barium fluoride crystals, as well as similar work being carried out at LLNL as well as other Institutes in the US and Europe.

27180 (EGG–10617-2168) **Optical properties and surface morphology studies of palladium contacts on mercuric iodide single crystals.** George, M.A. (Fisk Univ., Nashville, TN (United States). Dept. of Physics); Azoulay, M.; Burger, A.; Biao, Y.; Silberman, E.; Nason, D. EG and G Energy Measurements, Inc., Goleta, CA (United States). Santa Barbara Operations. [1993]. 16p. Sponsored by National Aeronautics and Space Administration, Washington, DC (United States). DOE Contract AC08-88NV10617. Grant NAGW–2925. (CONF-930419–2: International conference on metallurgical coatings and thin films, San Diego, CA (United States), 19-23 Apr 1993). Order Number DE93012510. Source: OSTI; NTIS; GPO Dep.

Palladium is chemically suitable for electric contacts on mercuric iodide detectors for photon and nuclear radiation detection, so the understanding of palladium contacts is important for fundamental and practical scientific purposes. A study has been conducted on the surface morphology of evaporated contacts using Atomic Force Microscopy (AFM) and optical transmission and reflection. Evaporated palladium coatings are typically nonuniform and may deposit selectively on mercuric iodide surface defects. Reflection measurements show that coating thickness and surface treatment affect intensity, position and shape of a reflected peak characteristic of the mercuric iodide structure. Results indicate that the band gap energy in the surface of the mercuric iodide is lowered by palladium contacts.

27181 (EGG–10617-2182) **Electronic characterization of mercuric iodide gamma ray spectrometers.** Gerrish, V.M. EG and G Energy Measurements, Inc., Goleta, CA (United States). Santa Barbara Operations. [1993]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC08-88NV10617. (CONF-930405–22: Spring meeting of the Materials Research Society, San Francisco, CA (United States), 12-16 Apr 1993). Order Number DE93015524. Source: OSTI; NTIS; INIS; GPO Dep.

During the past four years the yield of high resolution mercuric iodide (HgI_2) gamma ray spectrometers produced at EG&G/EM has increased dramatically. Data is presented which demonstrates a strong correlation between starting material and spectrometer performance. Improved spectrometer yields are attributed to the method of HgI_2 synthesis and to material purification procedures. Data is presented which shows that spectrometer performance is

correlated with hole mobility-lifetime products. In addition, the measurement of Schottky barrier heights on HgI_2 spectrometers has been performed using I-V curves and the photoelectric method. Barrier heights near 1.1 eV have been obtained using various contacts and contact deposition methods. These data suggest the pinning of the Fermi level at midgap at the HgI_2 surface, probably due to surface states formed prior to contact deposition.

27182 (ENEA-RT-INN–90-29) **Measure of radiation damage induced by gamma-rays source on organic scintillators and its recovery time.** Baccaro, S.; D'Atanasio, P.; Marini, G.; Gennis, M.; Mattioli, M.; Nigro, A.; Talice, S. ENEA, Casaccia (Italy). Area Energia e Innovazione; Rome Univ. (Italy). Dipt. di Fisica; Hamburg Univ. (Germany). 2. Inst. fuer Experimentalphysik. Dec 1990. 18p. (RT/INN–90-29). Order Number DE93799297. Source: OSTI; NTIS (US Sales Only); INIS.

The radiation damage to organic scintillating materials and wavelength shifters was investigated at total doses 10^3 -:- 4 x 10^4 Gy in air and in nitrogen environments. In the present experiment, the samples were exposed to the gamma-radiation from a ^{60} Co source (dose rate = 66.18 Gy/h). The radiation damage was measured by investigating the charge in light trasmittance and in the light output of the scintillators and wavelenght shifter. The results show that significant losses are caused to the plastic scintillator and WLS above 1kGy and that, generally, there appears to be a different behaviour between polyvinyltoluene base scintillators and other materials with respect to the environment.

27183 (ETDE-IT–93-164) **Whole body counters operating in Italy: MIDIA 1991 report.** Melandri, C.; Castellani, C.M.; Formignani, M.; Guidarelli, G. ENEA, Bologna (Italy). Jan 1992. 31p. (In Italian). Order Number DE93799240. Source: OSTI; NTIS (US Sales Only); INIS.

In 1991, MIDIA, an Italian radiation protection organization overseeing whole body counting activities in Italy, conducted a complete survey of whole body counters operating in Italy. This paper presents the tabled data classifying the counters according to various descriptive parameters: location, flexibility of use, shielding, measurement geometry, detector type number and size, type of calibration phantoms and radionuclides, background radiation values, measurement methods, equipment performance and maintenance characteristics.

27184 (ETDE-IT–93-164-Suppl.) **Whole body counters operating in Italy: MIDIA 1991 report. Supplement 'Whole body counters technical schedules'.** Melandri, C.; Castellani, C.M.; Formignani, M.; Guidarelli, G. ENEA, Bologna (Italy). 1992. 111p. (In Italian). Order Number DE93799241. Source: OSTI; NTIS (US Sales Only); INIS.

In 1991, MIDIA, an Italian radiation protection organization overseeing whole body counting activities in Italy, conducted a complete survey of whole body counters operating in Italy. This paper presents the tabled data classifying the counters according to various descriptive parameters: location, flexibility of use, shielding, measurement geometry, detector type number and size, type of calibration phantoms and radionuclides, background radiation values, measurement methods, equipment performance and maintenance characteristics.

27185 (FNAL/C–93/046-E) **The Dν upgrade silicon tracker.** Heinson, A.P. For the D0 Collaboration. Fermi National Accelerator Lab., Batavia, IL (United States). Nov 1992. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. (CONF-921122–63: Meeting of the Division of Particles and Fields of the American Physical Society, Batavia, IL (United States), 10-14 Nov 1992). Order Number DE93014717. Source: OSTI; NTIS; INIS; GPO Dep.

A large silicon strip tracking detector is planned for the upgrade of the D0 experiment at Fermilab. This detector is designed to gag secondary vertices, to measure the momenta of charged particles and to operate in the high rate environment of the upgraded Tevatron. Details of the detector design are presented here.

27186 (FNAL/C–93/049-E) **Low energy response of the D0 calorimeter and jet energy measurement.** Bhat, P.C. D0 Collaboration. Fermi National Accelerator Lab., Batavia, IL (United States). Nov 1992. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. (CONF-921122–57: Meeting of the Division of Particles and Fields of the American Physical Society, Batavia, IL (United States), 10-14 Nov 1992). Order Number DE93013569. Source: OSTI; NTIS; INIS; GPO Dep.

Previous studies of the Dν calorimeter with electron and hadron beams above 10 GeV/c have shown excellent linearity of response and e/π ratio close to one. Here we report on our measurements of the response of the DO central calorimeter modules down to 2 GeV/c. The measured low energy response for electrons and pions are fragmentation from the PYTHIA Monte Carlo to obtain the corrections for jet energy.

27187 (FNAL/C–93/148) **A fast ring-imaging Cherenkov counter for a fixed-target heavy-quark experiment.** Kaplan, D.M. (Northern Illinois Univ., De Kalb, IL (United States)); Isenhower, L.D.; Atac, M.; Brown, C.N.; Darden, C.W. Fermi National Accelerator Lab., Batavia, IL (United States). Jun 1993. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. (CONF-9306188–1: 1. workshop on rich detectors, Bari (Italy), 1-5 Jun 1993). Order Number DE93016471. Source: OSTI; NTIS; INIS; GPO Dep.

We present a design for a fast ring-imaging Cherenkov counter operating in the visible. The Cherenkov photons are imaged on an array of small Winston cones and read out with optical fibers and VLPCs. the design is optimized for π/K/p separation in the range $10 < p < 100$ GeV/c.

27188 (FNAL-TM–1824) **Dead material and energy measurements in hadronic calorimeters.** Green, D. Fermi National Accelerator Lab., Batavia, IL (United States). Jan 1993. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. Order Number DE93014927. Source: OSTI; NTIS; INIS; GPO Dep.

Often the question arises as to where is the optimal place to locate "dead" material in a calorimeter. This material may be needed for structural reasons, for example. There needs to be a quantified answer to the question of what damage this "dead" material does to the performance of a calorimeter. For the purposes of this note, a hadronic calorimeter (HAD) is characterized by the mean and standard deviation of the energy measurement made by that detector.

27189 (FNAL-TM–1837) **Sampling nonuniformity in the SDC calorimeter EM/HAD boundary.** Green, D. Fermi National Accelerator Lab., Batavia, IL (United States). Apr 1993. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. Order Number DE93014014. Source: OSTI; NTIS; INIS; GPO Dep.

The SDC steel hadronic (HAD) calorimeter absorber structure has been designed to be of low magnetic reluctance, high rigidity, and excellent hermiticity. Transverse scintillator tiles staggered longitudinally allow one to assemble the hadronic calorimeter compartment with no transverse dead areas between tiles. Clearly, the structure affords many advantages, among them hermeticity. The only problem is that, at the boundary of the structure, as at the E boundary, the steel sampling fraction for adjacent transverse towers is different. In principle then, the adjacent towers will have different energy calibrations, and different energy resolutions. The aim of this note is to examine the size of these effects and, ff necessary, explore ways to minimize their impact.

27190 (FNAL-TM–1838) **High counting rate resistive-plate chamber.** Peskov, V.; Anderson, D.F.; Kwan, S. Fermi National Accelerator Lab., Batavia, IL (United States). May 1993. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. Order Number DE93014928. Source: OSTI; NTIS; INIS; GPO Dep.

Parallel-plate avalanche chambers (PPAC) are widely used in physics experiments because they are fast (<1 ns) and have very simple construction: just two parallel metallic plates or mesh electrodes. Depending on the applied voltage they may work either in spark mode or avalanche mode. The advantage of the spark mode of operation is a large signal amplitude from the chamber, the disadvantage is that there is a large dead time (msec) for the entire chamber after an event. The main advantage of the avalanche mode is high rate capability 10^5 counts/mm^2. A resistive-plate

chamber (RPC) is similar to the PPAC in construction except that one or both of the electrodes are made from high resistivity ($\geq 10^{10}$ Ω-cm) materials. In practice RPCs are usually used in the spark mode. Resistive electrodes are charged by sparks, locally reducing the actual electric field in the gap. The size of the charged surface is about 10 mm^2, leaving the rest of the detector unaffected. Therefore, the rate capability of such detectors in the spark mode is considerably higher than conventional spark counters. Among the different glasses tested the best results were obtained with electron type conductive glasses, which obey Ohm's law. Most of the work with such glasses was done with high pressure parallel-plate chambers (10 atm) for time-of-flight measurements. Resistive glasses have been expensive and produced only in small quantities. Now resistive glasses are commercially available, although they are still expensive in small scale production. From the positive experience of different groups working with the resistive glasses, it was decided to review the old idea to use this glass for the RPC. This work has investigated the possibility of using the RPC at 1 atm and in the avalanche mode. This has several advantages: simplicity of construction, high rate capability, low voltage operation, and the ability to work with non-flammable gases.

27191 (GANIL-P–92-25) **Heavy scintillators in nuclear physics.** Matulewicz, T. (Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France)). Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France). 1992. [11p.] (CONF-9209253–: Crystal 2000 international workshop on heavy scintillators for scientific and industrial applications, Chamonix (France), 22-26 Sep 1992). Order Number DE93631552. Source: OSTI; NTIS (US Sales Only); INIS.

The major topics of basic nuclear research and the reasons for selecting specific scintillation materials are overviewed. Only few types of scintillators satisfy the demand and are commonly used in nuclear physics. The actual request of scintillation-based detectors are presented in the context of fundamental nuclear physics in the following areas: reaction mechanism, nuclear structure, physics of mesons and energetic photons in heavy-ion collisions. Few examples of advanced detectors already operational or expected to be so in a near future are discussed with the emphasis on the use of heavy scintillators (CsI, BGO, BaF_2, etc.). (R.P.) 23 refs.; 3 figs.

27192 (GANIL-P–92-26) **Quenching of scintillation in BaF_2 for light charged particles.** Matulewicz, T. (Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France)). Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France). 1992. [5p.] Order Number DE93631543. Source: OSTI; NTIS (US Sales Only); INIS.

Submitted to Nucl. Instrum. Methods Phys. Res., Sect.A (NL).

Detectors made of a barium fluoride (BaF_2) crystal have recently become popular in the spectroscopy of photons and light charged particles at intermediate energies. The quenching of the scintillation light of BaF_2 crystals is described in the framework of Birks law for light charged particles in the energy range of 20-100 A MeV. Based on the recently published data, the analysis yields a value of Birks constant equal to 1.8 ± 0.3 mg $MeV^{-1}cm^{-2}$ and a scintillation efficiency equal to 0.79 ± 0.05 $MeV_{ee}MeV^{-1}$. (R.P.) 10 refs.; 2 figs.

27193 (INIS-mf–12758, pp. 471-478) **Dose control in semi industrial irradiation plant at the Ezeiza Atomic Center.** Dorda, E.M. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina). Gerencia de Aplicaciones). Asociacion Argentina de Tecnologia Nuclear, Buenos Aires (Argentina). 1987. [735p.] (In Spanish). (CONF-8711355–: 15. scientific meeting and 4th Latin American meeting and 1st sessions on nuclear power plants, San Carlos de Bariloche (Argentina), 2-6 Nov 1987). In *Proceedings of the fifteenth scientific meeting; fourth Latin American meeting; first sessions on nuclear power plants.* Order Number DE91003052. Source: OSTI; NTIS (US Sales Only); INIS.

In 1975 a study was initiated at the Division of Dosimetry to develop a technique and a system of dosimetry to be applied to the radiosterilization processes in the semi industrial irradiation plant of Ezeiza Atomic Center. The result of this study was the potassium nitrate/nitrite dosimeter used as routine dosimeter for control processes in food conservation, with a dose range of 0.2 kGy-1 kGy and in radiosterilization processes of disposable medical products of 1 kGy-150kGy. The potassium nitrate crystals undergo a radiolytic reduction. A linear correlation between the dose applied to the solid and the production of potassium nitrite was observed. After the irradiation of solid, the produced nitrite solution is colorimetrically titrated by measuring the absorbency in a spectrophotometer at 504 nm. The color is due to the formation of a diazonium salt and its later copulation with N-1 naphtylethylendiamine hydrochloride in acid medium. In 1980 a postal survey was organized presenting this dosimeter to standardize the irradiation dose in industrial process for Latin America. This dosimeter was presented in 1984 at the International Symposium on High Doses of the IAEA that took place in Vienna. Since them, comparative studies were performed between this dosimeter and those internationally considered and accepted: cerium(IV)/cerium(III) sulphate, ionization chamber of parallel plates, alanine. The results of comparison with the alanine dosimeter, which was used by Dr. Regula of the GSF of Munich, were the following: February 1985: 0% deviation; February 1986: 0.43% deviation. (Author).

27194 (INIS-mf–13543, pp. 131-138) **Track detectors.** Burian, I. (Ustav Hygieny Prace v Uranovem Prumyslu, Kamenna (Czech Republic)). Ministerstvo Zivotniho Prostredi, Prague (Czech Republic); Okresni Urad, Jihlava (Czech Republic); Dum Kultury Odboru, Jihlava (Czech Republic). 1992. (In Czech). (CONF-9211241–: Conference on provisions against radon, Jihlava (Czech Republic), 23-25 Nov 1992). In *Conference on provisions against radon: Proceedings.* [232p.] Order Number DE93629294. Source: OSTI; NTIS (US Sales Only); INIS.

The systems used in Czechoslovakia for measuring radon and its daughter products are specified and the applicable detectors and measuring facilities are described. Integral track detectors, electrets, thermoluminescence materials, cellulose nitrate and polycarbonate are described and their assets and drawbacks are outlined, as are the ways of application and evaluation. (M.D.).

27195 (IYaF–91-118) **The gamma ray energy tagging spectrometer of ROKK-2 facility at VEPP-3 storage ring.** Kezerashvili, G.Ya.; Milov, A.M.; Vojtsekhowski, B.B. AN SSSR, Novosibirsk (Russian Federation). Inst. Yadernoj Fiziki. 1991. [24p.] Order Number DE93629753. Source: OSTI; NTIS (US Sales Only); INIS.

The gamma ray energy tagging spectrometer is described. The storage ring bending magnet was used as an analyzer for the gamma ray tagging spectrometer in the photon energy range from 1.5% up to 14% of the initial beam energy with the drift chambers as a coordinate detector. Factors determine the registration efficiency and the energy resolution of the tagging spectrometer are discussed. The tagging spectrometer energy resolution is measured by using the width of high energy edge of the Compton spectrum. The registration efficiency value consists 95% and the photon energy resolution is 4 MeV. 12 refs.; 10 figs.

27196 (IYaF–91-121) **High efficiency neutron spectrometer with low background.** Arzhannikov, A.V.; Kezerashvili, G.Ya.; Milov, A.M. AN SSSR, Novosibirsk (Russian Federation). Inst. Yadernoj Fiziki. 1991. [15p.] Order Number DE93629754. Source: OSTI; NTIS (US Sales Only); INIS.

A neutron energy spectrometer with a geometry close to 4π solid angle operated in the (1-5) MeV energy range at a suitable for a cold fusion experiment configuration and a very good n/γ discrimination, has been constructed. Tests of registration efficiency, energy resolution and radiation type identification have been made with a help of low intensity neutron and gamma sources. The spectrometer has shown the efficiency of about 10% at the $2 \times 10^{-3} s^{-1}$ background level and permits one to measure a neutron energy spectrum at a very low intensity of the source. Physical principles, design of the neutron detector system and results of its testing are described. 6 refs.; 6 figs.; 1 tab.

27197 (KAERC–903/89) **Manufacture of personal thermal neutron dosimeter with cadmium covered with $CaSO_4$(Dy).** Hyon Goom Sun, A.D.; Lyoo Hwa Choon. Ministry of Atomic Energy, Pyongyang (Korea, Democratic People's Republic of). Research Center for Atomic Energy. Feb 1989. [7p.] (In Korean). Order Number DE93628341. Source: OSTI; NTIS (US Sales Only); INIS.

We have made personal thermal neutron dosimeter with cadmium covered with $CaSO_4$(Dy) teflon dish which can be simply available. In mixture field where the ratio of thermal neutron and gamma ray dose rate is 2:1, thermal neutron dose may be measured with error less than +-15% from 10 to 10^4cy. (Author).

27198 (LA-UR-93-1640) **A neutron counter for small samples.** Sprinkle, J.K. Jr.; Menlove, H.O.; Miller, M.C.; Russo, P.A.; Jorgensen, C. Los Alamos National Lab., NM (United States). [1993]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930533-2: 15. annual symposium of the European Safeguards Research and Development Association: safeguards and nuclear materials management, Rome (Italy), 11-13 May 1993). Order Number DE93012709. Source: OSTI; NTIS; GPO Dep.

The Inventory Sample Counter Model IV is the most recent neutron coincidence counter specifically designed to measure small samples. We used a combination of measurement experience and Monte Carlo modeling to design a neutron counter that can provide measurement results with an accuracy of 0.5% or better. Some applications incorporate a high-resolution detector into the neutron counter. This allows the simultaneous measurement of the plutonium isotopics using the passive gamma-ray emission and the measurement of the ^{240}Pu effective mass using the passive neutron emission. The two results are then combined to yield the plutonium mass.

27199 (LA-UR-93-1715) **A flat-cathode thermionic injector for the PHERMEX Radiographic Facility.** Kauppila, T. (Los Alamos National Lab., NM (United States)); Builta, L.; Burns, M.; Gregory, W.; Honaberger, D.; Watson, S.; Hughes, T. Los Alamos National Lab., NM (United States); Mission Research Corp., Albuquerque, NM (United States). [1993]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930511-104: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014584. Source: OSTI; NTIS; INIS; GPO Dep.

The PHERMEX (Pulsed High-Energy Radiographic Machine Emitting X-rays) standing-wave linear accelerator is a high-current electron beam generator used for flash-radiography. An improved electron gun has been designed employing a flat-thermionic cathode to replace the existing Pierce-geometry gun. The flat cathode yields increased current with the same applied voltage and cathode area as the Pierce gun. The ISIS code simulations indicate a beam current of 1.5 kA at 600 kV. The new geometry also reduces the probability for high voltage breakdown in the A-K gap. A reentrant magnet captures the expanding electron beam and a bucking coil nulls cathode-tinge field. A third coil is used to optimize the extraction field profile and reduce the effect of nonlinear space charge on the beam emittance. Time-resolved measurements of beam current and voltage have been made. In addition, a streak camera was used to measure beam emittance and spatial profile. Comparisons of measurements with simulations are presented.

27200 (LA-UR-93-1727) **A miniature modular MCA for gamma-ray spectroscopy.** Sprinkle, J.K. Jr. (Los Alamos National Lab., NM (United States)); Halbig, J.K.; Klosterbuer, S.F.; Russo, P.A.; Smith, S.E. Los Alamos National Lab., NM (United States). [1993]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930533-8: 15. annual symposium of the European Safeguards Research and Development Association: safeguards and nuclear materials management, Rome (Italy), 11-13 May 1993). Order Number DE93014579. Source: OSTI; NTIS; INIS; GPO Dep.

A wide variety of user requirements in nondestructive assay field applications can be satisfied by carefully specifying a small number of standardized hardware and software modules and their interfaces. Examples of this philosophy will be presented with a novel, small multichannel analyzer (M^3CA) as 10 cm by 20 cm by 9 cm and includes a detector bias supply, amplifier, and battery.

27201 (LA-UR-93-1752) **First results from PHAROS, the new chopper spectrometer at LANSCE.** Olivier, B.J.; Sandoval, J.P.; Lysaght, P.; Nutter, M.; Robinson, R.A. Los Alamos National Lab., NM (United States). [1993]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9305177-4: 12. International collaboration of advanced neutron sources meeting (ICANS), Abingdon (United Kingdom), 24-28 May 1993). Order Number DE93014572. Source: OSTI; NTIS; INIS; GPO Dep.

In this article we present the first experimental measurements obtained on PHAROS during the 1992 run cycle at LANSCE. These are data on the phasing of the choppers relative to the accelerator system along with the consequent neutronic resolution, data on the real-space position resolution of the main detectors, a white-beam nickel powder calibration, and our first inelastic scattering measurement made on TiH_2 with an incident energy of 300 MeV. The characteristic features of the new chopper spectrometer PHAROS, designed for low-angle inelastic neutron scattering and neutron Brillouin scattering, are described elsewhere in these proceedings.

27202 (LBL-32612) **Scintillating tile fabrication for the 4 x 4 calorimeter test station module.** Hoff, M.D. Lawrence Berkeley Lab., CA (United States). 23 Jun 1992. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. Order Number DE93015288. Source: OSTI; NTIS; INIS; GPO Dep.

Short communication. SHOWER COUNTERS/design; SHOWER COUNTERS/plastic scintillators; PLASTIC SCINTILLATORS/fabrication; DESIGN; FABRICATION

27203 (LIYaF-1714) **Spark discharge guided by high energy particles beams.** Bekker, A.M.; Kozlov, V.S.; Ksenofontov, O.P.; Miroshkin, V.V.; Stabnikov, M.V.; Tarakanov, V.I. AN SSSR, Leningrad (Russian Federation). Inst. Yadernoj Fiziki. 1991. [18p.] (In Russian). Order Number DE93629762. Source: OSTI; NTIS (US Sales Only); INIS.

The features of a long-gap (some 10 cm) spark discharge in air and nitrogen with gas ionization induced by collimated beam of 300 MeV electrons have been studied experimentally. It is shown that the certain conditions are bound to be realized to make the discharge develop strictly along the beam axes. The main experimental results showing the mechanisms of discharge quiding are presented. Qualitative interpretation of the phenomena observed is proposed. Some approaches to the creation of the phenomenological model of a gas discharge are outlined. 8 refs.; 9 figs.

27204 (OEFZS-4663) **Investigations on commercial semiconductor diodes as possible high dose rate radiation detectors.** Breitenhuber, L. (Technische Univ., Graz (Austria). Inst. fuer Kernphysik); Kindl, P.; Obenaus, B.; Duftschmid, K.; Strachotinsky, C. Oesterreichisches Forschungszentrum Seibersdorf GmbH (Austria). Dec 1992. [37p.] (In German). Order Number DE93628343. Source: OSTI; NTIS (US Sales Only); INIS.

Provided with ISSN 0253-5270.

Investigations concerning the relevant properties of commercial semiconductor diodes such as their sensitivity and its dependence on accumulated dose, dose rate, energy, temperature and direction have been made in order to obtain their usefullness as radiation detectors. (authors).

27205 (ORNL/TM-12311) **Analysis of anomalous data produced by Harshaw Model 8801 thermoluminescent dosimeter cards.** Sonder, E.; Ahmed, A.B. Oak Ridge National Lab., TN (United States). May 1993. 25p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93015757. Source: OSTI; NTIS; INIS; GPO Dep.

A large number of dosimeters that have produced abnormal data during field assignment have been stored, reirradiated, and studied. Results are summarized and comparisons are made with normal dosimeters. Summarized here are anomalous glow curve shapes, distributions of anomalies in the residual luminescent responses, and historical and repeat-irradiation behavior of abnormal dosimeters. The results indicate that by far the most frequent abnormal data involve elevated readings from Chip 3, accompanied by excess luminescence at temperatures higher than that of the normal radiation produced band. There is no sharp division between normal and abnormal dosimeters (dosimeters yielding excess luminescence at high temperature). Rather, dosimeters exhibit a continuum of behavior from very good (little high temperature luminescence) to clearly abnormal behavior. The excess luminescence emitted at high temperature in abnormal dosimeters is not

proportional to absorbed dose; it has a radiation-independent average value that depends on the dosimeter but varies erratically above and below that average for consecutive anneals. At relatively high radiation exposures (>100 mR), the amount of excess high temperature luminescence becomes unimportant and abnormal data are rare.

27206 (SSCL–601) **3D-Flow processor for a programmable Level-1 trigger (feasibility study).** Crosetto, D. Superconducting Super Collider Lab., Dallas, TX (United States). Oct 1992. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. Order Number DE93016045. Source: OSTI; NTIS; INIS; GPO Dep.

A feasibility study has been made to use the 3D-Flow processor in a pipelined programmable parallel processing architecture to identify particles such as electrons, jets, muons, etc., in high-energy physics experiments.

27207 (SSCL–607) **General programmable Level-1 trigger with 3D-Flow assembly system for calorimeters of different sizes and event rates.** Crosetto, D. Superconducting Super Collider Lab., Dallas, TX (United States). Dec 1992. 21p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. Order Number DE93013944. Source: OSTI; NTIS; INIS; GPO Dep.

Experience demonstrates that fine tuning on the trigger of an experiment is often achieved only after running the experiment and analyzing the first data acquired. It is desirable that identification and, consequently, selection of interesting events be made on a more refined identification of particles. Use of an innovative parallel-processing system architecture together with an instruction set allows identification of objects (particles) among the data coming from a calorimeter in a programmable manner, utilizing the information related to their shape in two- or three-dimensional form, rather than applying only a programmable threshold proportional to their energy. The architecture is flexible, allowing execution of simple algorithms as well as complex pattern recognition algorithms. It is scalable in the sense that the same hardware can be used for small or large calorimeters having a slow or fast event rate. The simple printed circuit board (accommodating 16 x 3D-Flow processors) on a 4 in. x 4 in. board described herein uses the same hardware to build a large Level-1 programmable trigger (by interconnecting many boards in a matrix array) and is capable of implementing simple or complex pattern recognition algorithms at different event input rates (by cascading boards one on top of another). With the same hardware one can build low-cost, programmable Level-1 triggers for a small and low-event-rate calorimeter, or high-performance, programmable Level-1 triggers for a large calorimeter capable of sustaining up to 60 million events per second.

27208 (SSCL-Preprint–211) **An engineering design study of the support platform assembly for the SSC SDC detector.** Krebs, H.J. (Superconducting Super Collider Lab., Dallas, TX (United States)); Western, J.L.; Wands, R.H. Superconducting Super Collider Lab., Dallas, TX (United States). Apr 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930537–29: 5. annual international industrial symposium on the Super Collider and exhibition, San Francisco, CA (United States), 6-8 May 1993). Order Number DE93014162. Source: OSTI; NTIS; INIS; GPO Dep.

A large angular acceptance high energy physics particle detector is presently being designed by the Solenoidal Detector Collaboration for the purposes of doing high pt physics at the Superconducting Super Collider Laboratory. The support platform assembly is the structural device which transfers the 30,000 tonne gravitational load of the octagonally shaped muon barrel toroid and the other detector components to the foundation below. The detector components are very sensitive to differential deflection and rely on the barrel toroid and support platform for stability. The operational load path is provided by two pairs of inclined longitudinal plates resting at 67.5° on three pairs of plate girders that are positioned in-line in Z. The plate girders are held together laterally with 38 tie bars and supported vertically by the vertical adjustment system. The lateral stability of the inclined plates is provided by 22 stabilizer beams with cross bracing between each beam. The Z location of each split in the plate girder is coincident with the Z location of the gap in the calorimeter (4428 nun from the detector center.) The width of each split is 155 mm to allow installation of the alignment reference system. The collider beam line in the IR-8 underground experimental hall is oriented at a 2.16 mm/m slope from south to north as shown in Figure 2. The support is designed and installed to provide this slope at the top surface of the inclined plates. The assembled support rests on a ten foot thick steel reinforced 8000 psi concrete slab. The slab has a 2 mm differential deflection criteria under nominal gravitational loading.

27209 (SSCL-Preprint–293) **Overview of the superconducting magnet subsystem for the GEM detector at the SSC.** Deis, G. (Lawrence Livermore National Lab., CA (United States)); Bowers, J.; Chargin, A.; Heim, J.; House, A.; Johnson, C.; Oberst, G.; Pedrotti, L.; Swan, J.; Warren, R.; Wineman, S.; Yamamoto, R.; Camille, R.; East, G.; Marston, P.; Minervini, J.; Myatt,Superconducting Super Collider Lab., Dallas, TX (United States). Apr 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930511–14: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014104. Source: OSTI; NTIS; INIS; GPO Dep.

The SSC Laboratory plans to deploy two "large" detectors for the essential high-energy physics experiments at the initial startup of the collider. The GEM detector is optimized to emphasize precise measurement of photons and electrons, as well as precise tracking of high-energy muons. An essential part of the GEM detector is the magnet subsystem, which provides the magnetic field necessary for identification and high-resolution tracking of charged particles. This large superconducting magnet system, with ferromagnetic field-shapers, presents a variety of engineering challenges in superconductor technology, in magnet-winding technology, fabrication, assembly and installation of large and heavy components, and in ensuring the required high operating availability.

27210 (SSI–93-04) **Reference instrument for continuous radon measurement.** Moere, Hans. Swedish Radiation Protection Inst., Stockholm (Sweden). Jan 1993. [25p.] (In Swedish). Order Number DE93631537. Source: OSTI; NTIS; INIS.

A reference instrument for calibration of equipment used for continuous measurement of radon has been constructed. It is based on electrostatic precipitation and alpha spectroscopy of the radon daughter products.

27211 (UCRL-ID–111750) **A high-sensitivity neutron counter and waste-drum counting with the high-sensitivity neutron instrument.** Hankins, D.E.; Thorngate, J.H. Lawrence Livermore National Lab., CA (United States). Apr 1993. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93014370. Source: OSTI; NTIS; INIS; GPO Dep.

At Lawrence Livermore National Laboratory (LLNL), a highly sensitive neutron counter was developed that can detect and accurately measure the neutrons from small quantities of plutonium or from other low-level neutron sources. This neutron counter was originally designed to survey waste containers leaving the Plutonium Facility. However, it has proven to be useful in other research applications requiring a high-sensitivity neutron instrument.

27212 (UCRL-ID–113825) **Engineering elements of the muon alignment system.** Sawicki, R. Lawrence Livermore National Lab., CA (United States). 18 Feb 1993. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93014375. Source: OSTI; NTIS; GPO Dep.

The muon alignment system is a complex arrangement of straight line monitors integrated with numerous, high specific stiffness detection chambers and a large, low resonant frequency, aluminum support structure. The precision tolerances with which all of these components must be installed, aligned and maintained requires meticulous and integrated analysis and design of all of the subsystems. This report summarizes the status of the engineering effort that has been completed and a status of the design in general. At present. there is an overall concept that addresses and provides reasonable engineering solutions to all of the primary

alignment challenges. Precision measurement accuracies can be achieved with equipment proven with either off-the-shelf equipment or with technologies that have been successfully demonstrated in full-scale laboratory experiments. The stability of the structures have been analyzed and determined to be capable of satisfying the alignment tolerances. And a top level alignment sequence has been identified that permits rapid, and efficient installation of the alignment system in a very tight timetable. Although many engineering details remain to be completed and changes will occur as the design of all of the systems mature, a basic concept and philosophy has been established and is defined in this report.

27213 (UCRL-JC–105283) **Nonconventional methods for accurately calibrating germanium detectors.** Gunnink, R.; Prindle, A.L. Lawrence Livermore National Lab., CA (United States). 1 Apr 1991. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-910422–11: International topical conference on methods and applications of radioanalytical chemistry II (MARC-2), Kona, HI (United States), 21-27 Apr 1991). Order Number DE93015113. Source: OSTI; NTIS; GPO Dep.

We have developed two nonconventional but complementary methods whereby the detector efficiency of a coaxial germanium detector can be determined within an accuracy of a few percent for the energy region from 0.05 to 4.0 MeV without using conventional radioactive standards.

27214 (UCRL-JC–109421) **Measurements of optical properties of waveshifting optical fiber for liquid scintillator hadron calorimetry.** Cochran, C.; Lowry, M.; Wuest, C.; Armatis, P.; Graham, G.; Ables, E. Lawrence Livermore National Lab., CA (United States). Sep 1992. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-920792–52: Society of Photo-Optical Instrumentation Engineers (SPIE) international symposium on optical applied science and engineering, San Diego, CA (United States), 19-24 Jul 1992). Order Number DE93012606. Source: OSTI; NTIS; GPO Dep.

Measurements have been made on optical properties of Bicron BCF-91 waveshifting optical fiber. This fiber is proposed as a means of converting UV and blue light emitted from liquid scintillator when exposed to ionizing radiation. The conversion is accomplished by coiling the fiber in a reservoir filled with liquid scintillator and coated internally with reflective paint. UV and blue light is absorbed by the waveshifting dyes in the fiber and reemitted light is channeled into the core of the fiber and output to photo detectors. It has been proposed to outfit the hadron calorimeter sub-system of the GEM detector to be built at the Superconducting Super Collider with 800,000 separate liquid scintillator/waveshifting fiber cells. The measurements described in this work deal with the optical performance of the fiber: spectral emission, response as a function of input wavelength, response as a function of irradiated length, propagation length and output numerical aperture. The theoretical response of an ideal calorimeter cell is studied based on the results of the measurements presented.

27215 (UCRL-JC–111941) **An x-ray detector using superconducting aluminum tunnel junctions.** Barber, W.C. (San Francisco State Univ., CA (United States). Dept. of Physics and Astronomy); Bland, R.W.; Carpenter, J.W.; Johnson, R.T.; Laws, K.E.; Lockhart, J.; Lee, J.S.; Watson, R.M.; Labov, S.E.; Cunningham, C.E.; LeGros, M.A.; Mears, C.A.; Morris,.Lawrence Livermore National Lab., CA (United States). [1992]. 13p. Sponsored by USDOE, Washington, DC (United States); National Science Foundation, Washington, DC (United States). DOE Contract W-7405-ENG-48 ;FG03-92ER40711. (CONF-920792–63: 37. annual Society of Photo-Optical Instrumentation Engineers (SPIE) international symposium on optical and optoelectronic applied science and engineering, San Diego, CA (United States), 19-24 Jul 1992). Order Number DE93015103. Source: OSTI; NTIS; INIS; GPO Dep.

We report on tests of a prototype detector for 6-keV X-rays, using series arrays of tunnel junction. Tests with higher-energy particles indicate an energy resolution of 4 keV, at 0.3K and with a warm pre-amp. At lower temperatures and with a cooled FET, the resolution should approach 100 eV.

4402 Radiation Effects On Instrument Components, Instruments, Or Electronic Systems

27216 (INT–248/PS) **Fast neutron damage of silicon pin photodiodes.** Dabrowski, W.; Korbel, K.; Skoczen, A. Institute of Physics and Nuclear Techniques, Cracow (Poland). 1990. [26p.] Programme CPBP 01.09. Order Number DE93629782. Source: OSTI; NTIS (US Sales Only); INIS.

A Hamamatsu Photonics photodiode S1723 was tested with respect to the fast neutron radiation. The device was irradiated with neutrons of energies in the range of 0.5 MeV to 12 MeV from a Po-Be source. The irradiation was performed in several steps starting from the relatively low fluence of 2.5×10^{10} n x cm^{-2}. The following characteristics were measured: leakage current vs bias voltage, capacitance vs bias voltage and vs frequency, noise vs time constant of a quasigaussian shaper and spectral density of noise. Significant changes of the leakage current and of the noise were observed at the fluence of neutrons as low as 2.5×10^{10} n x cm^{-2}. 8 figs., 3 tabs., 15 refs. (author).

4404 Well Logging Instrumentation

Refer also to citation(s) 27432, 27665

27217 **Compact acoustic refrigerator.** Bennett, G.A. To Dept. of Energy. 1991. Filed date 4 Jun 1991. USA patent application 7-710,207. 32p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93015703. Source: OSTI; NTIS; GPO Dep.

This invention is comprised of a compact acoustic refrigeration system that actively cools components, e.g., electrical circuits, in a borehole environment. An acoustic engine includes first thermodynamic elements for generating a standing acoustic wave in a selected medium. An acoustic refrigerator includes second thermodynamic elements located in the standing wave for generating a relatively cold temperature at a first end of the second thermodynamic elements and a relatively hot temperature at a second end of the second thermodynamic elements. A resonator volume cooperates with the first and second thermodynamic elements to support the standing wave. To accommodate the high heat fluxes required for heat transfer to/from the first and second thermodynamic elements, first heat pipes transfer heat from the heat load to the second thermodynamic elements and second heat pipes transfer heat from first and second thermodynamic elements to the borehole environment.

4406 Optical Instrumentation

Refer also to citation(s) 25893, 25896, 25909, 26822, 26893, 26954, 27316, 27317, 27519, 27633, 27710

27218 (DOE/ER/14090–4) **Pulse propagation in inhomogeneous optical waveguides: Progress report, September 15, 1992–September 14, 1993.** Menyuk, C.R. Maryland Univ., Baltimore, MD (United States). Dept. of Electrical Engineering. 28 Apr 1993. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-89ER14090. Order Number DE93013378. Source: OSTI; NTIS; GPO Dep.

This report discusses pulse propagation in inhomogeneous optical waveguides and fibers.

27219 (LA-UR–93-1449) **Polarization effects in optical fiber current sensors based on Sagnac interferometers with 3×3 couplers.** Rochford, K.B. (National Inst. of Standards and Technology, Boulder, CO (United States)); Day, G.W.; Forman, P.R. Los Alamos National Lab., NM (United States). [1993]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930588–2: 9. optical fiber sensors conference, Firenze (Italy), 4-6 May 1993). Order Number DE93012665. Source: OSTI; NTIS; GPO Dep.

Response functions of an ideal Sagnac optical fiber cut-rent sensor based on a 3×3 coupler fundamentally depend on the polarization state of light catering coupler, even for a zero birefringence system. The desired response functions, cosinusoids

separated by 120° phase shifts, are obtained only for circularly polarized light. The response functions for linearly polarized and depolarized inputs are cosinusoids separated by 180°, and yield only zero- slope small-signal responses. Also, two outputs are degenerate, so that the response is similar to that observed in 2×2 systems. Thus, 3×3 couplers offer no advantage over 2×2 systems for linear polarized light. This result increases system complexity in that polarization control optics are required to supply the proper polarization, even for an ideal, zero-birefringence system.

27220 (ORNL/FTR–4634) **Travel to England and the Netherlands for a performance evaluation of scanning and electron microscopes equipped with field emission guns: Foreign trip report, April 27–May 5, 1993.** Kenik, E.A.; Bentley, J. Oak Ridge National Lab., TN (United States). 2 Jun 1993. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93016671. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Comprehensive tests of imaging and analytical performance of two scanning electron microscopes and a 200-kV transmission electron microscope, each equipped with Schottky field emission guns, were performed with a variety of special test specimens and ones typically encountered in current research at Oak Ridge National Laboratory. The test results will be invaluable in guiding future acquisitions of such instruments. Discussions at Delft Technological University provided information on important instrumentation projects well in advance of general publication.

27221 (ORNL/FTR–4650) **Travel to Japan for a performance evaluation of the Hitachi HF2000 cold field emission gun analytical electron microscope: Foreign trip report, May 16–22, 1993.** Bentley, J. Oak Ridge National Lab., TN (United States). 18 Jun 1993. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93016672. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Comprehensive tests of imaging and analytical performance of the Hitachi HF2000 cold field emission gun (FEG) analytical electron microscope (AEM) were performed with a variety of special test specimens and ones typically encountered in current research at Oak Ridge National Laboratory (ORNL). The test results will be invaluable in guiding future acquisitions of high-performance AEMs. Visits to the Central and Advanced Research Laboratories of Hitachi, Ltd., provided much useful information on important electron microscopy instrumentation projects and research.

27222 (UCRL-ID–113834) **Barium fluoride research and development at Lawrence Livermore National Laboratory.** Wuest, C.R.; Fuchs, B.A.; Kway, W. Lawrence Livermore National Lab., CA (United States). 24 Jul 1992. 127p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93014682. Source: OSTI; NTIS; GPO Dep.

Lawrence Livermore National Laboratory (LLNL) has been asked to provide R&D on new methods of barium fluoride (BaF_2) crystal surface preparation, as well as optical coating methods to improve the efficiency of transport of scintillation light through the crystal to the photodetector. The goal of the R&D is to identify a method (or methods) for preparing the surface to eliminate the amorphous layer that has been found to be a product of the surface preparation techniques used when the crystals are manufactured in China and provide a crystalline surface free from oxygen and other contamination, with suitable flatness for optical coating. UV reflective coatings have been identified that are suitable for the wavelengths of the scintillation light (220 nm peak). The coating consists of a layer of aluminum with a magnesium fluoride over-layer. This coating can be applied in a uniform layer or in a graded layer, with reflectance varying as a function of position. It is ultimately desired that the UV coating be applied with graded reflectance to linearize the response of the crystal along its length.

27223 (UCRL-JC–109219-Rev.2) **Tip-tilt compensation: Resolution limits for ground-based telescopes using laser guide star adaptive optics: Revision 2.** Olivier, S.S.; Max, C.E.; Gavel, D.T.; Brase, J.M. Lawrence Livermore National Lab., CA (United States). 8 Oct 1992. 52p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9203139–5-Rev.2: Laser guide star adaptive optics workshop, Albuquerque, NM (United States), 10-12 Mar 1992). Order Number DE93016426. Source: OSTI; NTIS; INIS; GPO Dep.

The angular resolution of long-exposure images from ground-based telescopes equipped with laser guide star adaptive optics systems is fundamentally limited by the the accuracy with which the tip-tilt aberrations introduced by the atmosphere can be corrected. Assuming that a natural star is used as the tilt reference, the residual error due to tilt anisoplanatism can significantly degrade the long-exposure resolution even if the tilt reference star is separated from the object being imaged by a small angle. Given the observed distribution of stars in the sky, the need to find a tilt reference star quite close to the object restricts the fraction of the sky over which long-exposure images with diffraction limited resolution can be obtained. In this paper, the authors present a comprehensive performance analysis of tip-tilt compensation systems that use a natural star as a tilt reference, taking into account properties of the atmosphere and of the Galactic stellar populations, and optimizing over the system operating parameters to determine the fundamental limits to the long-exposure resolution. Their results show that for a ten meter telescope on Mauna Kea, if the image of the tilt reference star is uncorrected, about half the sky can be imaged in the V band with long-exposure resolution less than 60 milli-arc-seconds (mas), while if the image of the tilt reference star is fully corrected, about half the sky can be imaged in the V band with long-exposure resolution less than 16 mas. Furthermore, V band images long-exposure resolution of less than 16 mas may be obtained with a ten meter telescope on Mauna Kea for unresolved objects brighter than magnitude 22 that are fully corrected by a laser guide star adaptive optics system. This level of resolution represents about 70% of the diffraction limit of a ten meter telescope in the V band and is more than a factor of 45 better than the median seeing in the V band on Mauna Kea.

27224 (UCRL-JC–112671) **Laser beam control and diagnostic systems for the copper-pumped dye laser system at Lawrence Livermore National Laboratory.** Bliss, E.S.; Peterson, R.L.; Salmon, J.T.; Thomas, R.A. Lawrence Livermore National Lab., CA (United States). Nov 1992. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-930159–41: OE/LASE '93: International Society for Optical Engineering (SPIE) conference, Los Angeles, CA (United States), 16-23 Jan 1993). Order Number DE93016529. Source: OSTI; NTIS; GPO Dep.

The laser system described in the previous paper is used for experiments in which success requires tight tolerances on beam position, direction, and wavefront. Indeed, the optimum performance of the laser itself depends on careful delivery of copper laser light to the dye amplifiers, precise propagation of dye laser beams through restricted amplifier apertures, and accurate monitoring of laser power at key locations. This paper describes the alignment systems, wavefront correction systems, and laser diagnostics systems which ensure that the control requirements of both the laser and associated experiments are met. Because laser isotope separation processes utilize more than one wavelength, these systems monitor and control multiple wavelengths simultaneously.

27225 (UCRL-JC–113273) **Imaging Fourier Transform Spectrometer.** Bennett, C.L.; Carter, M.R.; Fields, D.J.; Hernandez, J. Lawrence Livermore National Lab., CA (United States). 14 Apr 1993. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-930445–18: Society of Photo-Optical Instrumentation Engineers (SPIE) OE/aerospace science and sensing meeting, Orlando, FL (United States), 11-16 Apr 1993). Order Number DE93017193. Source: OSTI; NTIS; GPO Dep.

The operating principles of an Imaging Fourier Transform Spectrometer (IFTS) are discussed. The advantages and disadvantages of such instruments with respect to alternative imaging spectrometers are discussed. The primary advantages of the IFTS are the capacity to acquire more than an order of magnitude more spectral channels than alternative systems with more than an order of magnitude greater etendue than for alternative systems. The primary disadvantage of IFTS, or FTS in general, is the sensitivity to temporal fluctuations, either random or periodic. Data from the IRIFTS

(ir IFTS) prototype instrument, sensitive in the infrared, are presented having a spectral sensitivity of 0.01 absorbance units, a spectral resolution of 6 cm^{-1} over the range 0 to 7899 cm^{-1}, and a spatial resolution of 2.5 mr.

4407 Geophysical and Meteorological Instrumentation

Refer also to citation(s) 26059, 26898, 27258

27226 (USGS-OFR–93-187) **A portable vacuum hammer seismic source for use in tunnel environments.** Carroll, R.D.; Magner, J.E. Geological Survey, Denver, CO (United States). 1993. 37p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93015498. Source: OSTI; NTIS; US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225 (US); GPO Dep.

Concern for the measurement of seismic refraction velocities in tunnel areas where cables, construction features, and other sensitive structures render the use of dynamite sources unwise, resulted in the design of a vacuum-driven impact system utilizing a 43-kg (94-lb) weight in a 2-m (6.5-ft) tube. The system is portable, quickly assembled and disassembled, and requires only standard electrical power, an air pressure supply, and a laboratory vacuum pump to operate. The maximum weight of any component is 84 kg (185 lb), the remaining components being significantly lighter. Tests in volcanic rock tunnels in Rainier Mesa at the Nevada Test Site indicate maximum energy generated by the system is in the SV wave. When the system was employed at angles other than vertical, a polarized SH mode was also observed. The hammer was used to obtain velocities in an in-hole survey in a 138-m horizontal hole drilled behind the flat face of the Red Hot chamber after the Red Hot nuclear detonation. A large decrease was observed in compressional velocity compared with pre-event values. Because 20 years have elapsed since the explosion, one cannot separate the effect of ground shock on lowering the velocity from possible effects of destressing around adjacent underground openings over this period.

4408 Miscellaneous Instrumentation

Refer also to citation(s) 25558, 25639, 25893, 25915, 26851, 26852, 26853, 26909, 26933, 27037, 27082, 27242, 27276, 27277, 27278, 27281, 27282, 27283, 27284, 27285, 27286, 27287, 27288, 27289, 27290, 27291, 27292, 27293, 27296, 27301, 27305, 27306, 27459, 27668

27227 (LA-UR–93-1523) **High-speed imaging of blood splatter patterns.** McDonald, T.E. (Los Alamos National Lab., NM (United States)); Albright, K.A.; King, N.S.P.; Yates, G.J.; Levine, G.F. Los Alamos National Lab., NM (United States). [1993]. 6p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9306163–1: Items '93: an imaging technology conference and exposition, Washington, DC (United States), 6-10 Jun 1993). Order Number DE93012739. Source: OSTI; NTIS; GPO Dep.

The interpretation of blood splatter patterns is an important element in reconstructing the events and circumstances of an accident or crime scene. Unfortunately, the interpretation of patterns and stains formed by blood droplets is not necessarily intuitive and study and analysis are required to arrive at a correct conclusion. A very useful tool in the study of blood splatter patterns is high-speed photography. Scientists at the Los Alamos National Laboratory, Department of Energy (DOE), and Bureau of Forensic Services, State of California, have assembled a high-speed imaging system designed to image blood splatter patterns. The camera employs technology developed by Los Alamos for the underground nuclear testing program and has also been used in a military mine detection program. The camera uses a solid-state CCD sensor operating at approximately 650 frames per second (75 MPixels per second) with a microchannel plate image intensifier that can provide shuttering as short as 5 ns. The images are captured with a laboratory high-speed digitizer and transferred to an IBM compatible PC for display and hard copy output for analysis. The imaging system is described in this paper.

27228 (SAND–92-2210C) **Non-scanned LADAR imaging and applications.** Anthes, J.P.; Garcia, P. Pierce, J.T.; Dressendorfer, P.V. Sandia National Labs., Albuquerque, NM (United States). [1992]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-930445–14: Society of Photo-Optical Instrumentation Engineers (SPIE) OE/aerospace science and sensing meeting, Orlando, FL (United States), 11-16 Apr 1993). Order Number DE93013772. Source: OSTI; NTIS (US Sales Only); GPO Dep.

A scannerless LAser Detection And Ranging (LADAR) system is presently in development for applications at Sandia National Laboratories. This LADAR design eliminates the need for a mechanical laser beam scanner which is often the system component that limits the use of laser radars for many applications. Range to the target scene is determined in this approach by measuring the phase shift of the intensity modulation on the received optical return compared to the reference. The approach used in this LADAR is unique because the method used to detect this phase shift is an array of time integrating detectors that also records the image of the target scene. An analytical model will be presented that describes the LADAR system performance. Applications of this LADAR system will also be reviewed. They include terminal guidance of advanced conventional munitions, perimeter surveillance of secure facilities, mapping potholes/cracks in the US highway system for improved maintenance scheduling, active collision avoidance of commercial/private vehicles, robotic vision integrated into advanced manufacturing concepts, and a novel airborne multisensor system containing LADAR, SAR, and LIDAR to locate and measure the thickness of ocean oil spills.

27229 (SAND–92-2816) **Calibration of a magnetic induction system for measurement of hypervelocities.** Breeze, S.P. Sandia National Labs., Albuquerque, NM (United States). Mar 1993. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93013949. Source: OSTI; NTIS (US Sales Only); GPO Dep.

A device to measure the velocity and to determine the character of a material launched in a flight tube during the execution of an experiment has been constructed. This measurement devise provides a self generating signal, is nonintrusive, compact, and accurate. The signals are reproducible, and it is relatively inexpensive to procure. The MAgnetic Velocity Induction System (MAVIS) has been the technique used to measure projectile velocities in the two-stage light gas gun at Sandia for many years. Several experiments were conducted to study the MAVIS data signatures produced by various metal projectiles at velocities raging from 0.8 km/sec to nearly 7.0 km/sec, as well as fragmented metal projectiles, and a highly conductive carbon plasma. This report deals with the results of those calibration experiments. The data signature study may be used as an aid in the interpretation of the other test data records.

27230 (SAND–93-0370C) **Determination of equivalent circuit for PVDF shock-pressure gauges.** Kotulski, J.D.; Anderson, M.U.; Brock, B.C.; Gomez, J.; Graham, R.A.; Vittitoe, C.N. Sandia National Labs., Albuquerque, NM (United States). [1993]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9306167–8: 14. international conference on high pressure science and technology and 1993 technical meeting of the topical group on shock compression of condensed matter, Colorado Springs, CO (United States), 28 Jun - 3 jul 1993). Order Number DE93016492. Source: OSTI; NTIS; GPO Dep.

Broadband impedance measurements of a PVDF shock-pressure gauge are used to build an equivalent circuit for the gauge. The essential components are a gauge capacitance and a low-loss transmission line. Component features are consistent with the physical characteristics. With knowledge of this circuit, troublesome oscillations can be anticipated and prevented.

27231 (UCRL-ID–113844) **DATAA: Data acquisition made easy: A general purpose data acquisition program for digital oscilloscopes and digital data recorders.** Hodgin, R.L. Lawrence Livermore National Lab., CA (United States). Oct 1992. 21p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93014683. Source: OSTI; NTIS; GPO Dep.

'DATAA' was written to fill the need for a versatile, general purpose data acquisition program for digital scopes and data recorders. Unfortunately, a 'GPIB' software standard was only recently developed for such instruments. For operating the older, pre-standard digital scopes, different software for each instrument is usually required. The concept for this program is that the operator controls the instrument settings. The computer controls the data acquisition. 'Let the operator do what he does best, let the computer do what it does best.' In a research environment, the diagnostic setup requirements are constantly changing. Reliable, reproducible data is essential. 'DATAA' accomplishes this task. Data is automatically stored, with setup information being included with each data file. A plotting routine allows for easy examination of all data. For hardcopies, data files are printed at 300DPI to a Laser Jet printer. This report contains a brief description of each main command. Included are figures showing the main display screens, and sample waveform charts.

27232 (UCRL-ID–114251) **Passive tracking of a target using an array of sensors.** Buhl, M. Lawrence Livermore National Lab., CA (United States). May 1993. 52p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93015870. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The problem of passively tracking a moving signal source has importance in a variety of applications such as radar, sonar, seismology, and radio astronomy. In an attempt to aid in the understanding of such problems, a passive tracking algorithm has been developed using PV-Wave, version 3.10. The objective of this document is to present this algorithm, thereby allowing others to further investigate such problems.

27233 (UCRL-JC–111801) **Imaging microscopy with x-ray lasers at LLNL.** Da Silva, L.B. (Lawrence Livermore National Lab., CA (United States)); Trebes, J.E.; Mrowka, S.; MacGowan, B.J.; Koch, J.A.; Matthews, D.L.; Barbee, T.W. Jr.; Balhorn, R.; Gray, J.; Andersen, E.; Kern, D.; Attwood, D. Lawrence Livermore National Lab., CA (United States). 28 Jul 1992. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-920792–59: Society of Photo-Optical Instrumentation Engineers (SPIE) international symposium on optical applied science and engineering, San Diego, CA (United States), 19-24 Jul 1992). Order Number DE93013419. Source: OSTI; NTIS; GPO Dep.

Imaging microscopy with short pulse (200 ps) x-ray lasers offers the opportunity of high resolution three-dimensional imaging of specimens in an aqueous environment without the blurring effects associated with natural motion. As a first step towards this goal we have performed imaging, experiments which clearly resolved 500 A features on a gold test pattern. In addition, we have taken images of dried biological specimens as a basis for comparison in future wet specimen imaging. Results of these experiments will be described. We also discuss some of the alignment problems involved in doing x-ray microscopy with low rep rate systems where in situ focusing of the imaging optics is not practical as single shot exposures can alter the specimen.

45 MILITARY TECHNOLOGY, WEAPONRY, AND NATIONAL DEFENSE

Refer also to citation(s) 25897, 26497, 27228, 27229, 27395, 27396, 27397, 28199

27234 (KCP–613-5125) **Pin grid arrays: Final report.** Obenland, D.R. Allied-Signal Aerospace Co., Kansas City, MO (United States). Kansas City Div. Jun 1993. 23p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00613. Order Number DE93016579. Source: OSTI; NTIS; GPO Dep.

The evolution of electronic assemblies towards smaller packaging requirements has led to the need to investigate the potential of incorporating higher density packaging in the form of pin grid arrays (PGAs) for weapons hardware. This study investigated the processes required to pretin, solder, and rework PGA solder terminations.

27235 (LA-UR–93-1367) **Use of the new Los Alamos Pulsed Intense X-Ray (PIXY) for deep-penetration radiography in conventional munitions research and development.** Fradkin, D.B.; Sullivan, G.W.; Stout, L.E. Los Alamos National Lab., NM (United States). [1993]. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9303128–2: 6. test technology symposium, Baltimore, MD (United States), 30 Mar 1993). Order Number DE93012685. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The Pulsed Intense X-Ray machine, PIXY, is a state-of-the-art, flash x-ray machine recently installed at the Los Alamos National Laboratory (LANL). In today's environment of reduced fiscal resources, accurate computer modeling is being used to reduce the number of experimental tests required in research and development. Deep-penetration radiography is an excellent diagnostic tool for bench-marking hydro and finite-element computer codes. PIXY will be a cost-effective diagnostic tool for development and performance testing of future weapons systems. Examples of its use in conventional munitions research and development are presented.

27236 (MLM–3784) **Security guide for subcontractors.** Adams, R.C. Mound, Miamisburg, OH (United States). Jun 1993. 59p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-88DP43495. Order Number DE93017107. Source: OSTI; NTIS; GPO Dep.

This guide is provided to aid in the achievement of security objectives in the Department of Energy (DOE) contractor/subcontractor program. The objectives of security are to protect information that, if released, would endanger the common defense and security of the nation and to safeguard plants and installations of the DOE and its contractors to prevent the interruption of research and production programs. The security objective and means of achieving the objective are described. Specific security measures discussed in this guide include physical barriers, personnel identification systems, personnel and vehicular access control, classified document control, protection of classified matter in use, storing classified matter, and repository combinations. Means of dealing with security violations and security infractions are described. Maintenance of a security education program is discussed. Also discussed are methods of handling clearance terminations, visitor control, travel to sensitive countries, and shipment security. The Technical Surveillance Countermeasures Program (TSCM), the Computer Security Program, and the Operations Security Plan (OPSEC) are examined.

27237 (PNL-SA–22163) **Attached charge.** Cliff, W.C. Pacific Northwest Lab., Richland, WA (United States). Apr 1993. 3p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-9303163–1: American Defense Preparedness Association course, Ft. Walton Beach, FL (United States), 22-26 Mar 1993). Order Number DE93013151. Source: OSTI; NTIS (US Sales Only); GPO Dep.

In 1989 a successful feasibility demonstration was carried out by PNL for the Tank Main Armament System of the US Army. These tests conclusively showed that the attached charges remained with the projectiles throughout the travel down the barrel. The test system employed a Very High Burn Rate cast propellant affixed in the rear of 16 pound 120 mm projectiles in a cigarette burn configuration. The propellants were ignited by the breech propellant and burned continuously through the length of the barrel; and, in fact, at lower pressures, continued burning exterior to the barrel. Such a device can maintain a high base pressure and significantly improve a gun's performance. A next-generation system is being built for the US Navy in which an attached charge canister acts as a pusher system behind the projectile. The attached charge canister is then discarded upon leaving the muzzle. In this system the additional parasitic weight of the attached charge canister is not carried with the projectile and therefore does not influence the projectile aerodynamics. The attached charge concept has applications for large, small and medium caliber gun systems. It has currently been demonstrated on the 120 mm size system as well as a small bore 7.62 mm gun system. It has application for range extension, kinetic energy enhancement, and potentially for use in equation-of-state testing. With the attached charge concept the theoretical launch velocity for the attached charge projectile is principally dependent

on the charge to projectile mass ratio. There is no theoretical upper velocity limit at which a projectile could be launched, such as there is with a conventional propellant.

27238 (SAND–92-1411) **Experimental aerodynamics research on a hypersonic vehicle.** Oberkampf, W.L.; Aeschliman, D.P.; Tate, R.E.; Henfling, J.F. Sandia National Labs., Albuquerque, NM (United States). Apr 1993. 136p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93013957. Source: OSTI; NTIS; GPO Dep.

Aerodynamic force and moment measurements and flow visualization results are presented for a hypersonic vehicle configuration at Mach 8. The basic vehicle configuration is a spherically blunted 10° half-angle cone with a slice parallel with the axis of the vehicle. On the slice portion of the vehicle, a flap could be attached so that deflection angles of 10°, 20° and 30° could be obtained. All of the experimental results were obtained in the Sandia Mach 8 hypersonic wind tunnel for laminar boundary layer conditions. Flow visualization results include shear stress sensitive liquid crystal photographs, surface streak flow photographs (using liquid crystals), and spark schlieren photographs and video. The liquid crystals were used as an aid in verifying that a laminar boundary layer existed over the entire body. The surface flow photo-graphs show attached and separated flow on both the leeside of the vehicle and near the flap. A detailed uncertainty analysis was conducted to estimate the contributors to body force and moment measurement uncertainty. Comparisons are made with computational results to evaluate both the experimental and numerical results. This extensive set of high-quality experimental force and moment measurements is recommended for use in the calibration and validation of relevant computational aerodynamics codes.

27239 (SAND–92-1888C) **Parachute system design, analysis, and simulation tool: Status report.** Sundberg, W.D.; McBride, D.D.; Gwinn, K.W.; Waye, D.E.; Hailey, C.E. Sandia National Labs., Albuquerque, NM (United States). [1992]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-930580–3: 12. Royal Aeronautical Society/American Institute of Aeronautics and Astronautics (RAS/AIAA) aerodynamic decelerator systems technical conference, London (United Kingdom), 10 May 1993; AIAA–93-1208). Order Number DE93013755. Source: OSTI; NTIS; GPO Dep.

For over twenty years designers at Sandia National Laboratories have developed various parachute simulation codes to model deployment, inflation, loading, trajectories, aircraft downwash and line sail. In addition to these codes, material property data bases have been acquired. Recently we have initiated project to integrate these codes and data bases into a single software tool entitled SPARSYS (Sandia PARachute SYstem Simulation). We have constructed a graphical user interface as the driver and framework for SPARSYS. In this paper we present a status report on SPARSYS describing progress in developing and incorporating independent modules, in developing an integrated trajectory package, and in developing a materials data base including high-rate-of-strain data.

27240 (SAND–92-1891C) **Test/analysis correlation and model updating of the STARS I & II missile systems.** Fulcher, C.W.; Marek, E.L.; Mayes, R.L. Sandia National Labs., Albuquerque, NM (United States). [1992]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-930786–1: 1. Dynamic Testing Agency/National Agency for Finite Element Methods and Standards International conference, Milton Keynes (United Kingdom), 7-9 Jul 1993). Order Number DE93013774. Source: OSTI; NTIS; GPO Dep.

The testing, modeling, and test/analysis correlation of the STARS I & II missile systems is reviewed. The STARS project is described. The system identification methodology is discussed. A series of modal tests designed to characterize the various structural components is summmarized. The development and updating of detailed finite element models, in a test/analysis correlation process, is presented.

27241 (UCRL-ID–113846) **Real time radiography of Titan IV booster.** La Chapell, M.; Turner, D.; Dolan, K.; Perkins, D.; Costerus, B. Lawrence Livermore National Lab., CA (United States). Apr 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93012450. Source: OSTI; NTIS; GPO Dep.

Lawrence Livermore National Laboratory successfully completed.a real time radiography of the Titan IV booster motor in February 1993. The success of this project depended on the quick response-to Air Force criteria and securing a multi disciplinary team addressing the numerous technical challenges. The team's Challenges included large area imager design and fabrication problems; vibrating mitigation obstacles; sound mitigation dilemmas; high levels of fail safe confidence; and operating a fragile, transportable x-ray linear accelerator. The data was viewed real-time and stored utilizing standard video hardware. The data from the test is presently being analyzed. The multi disciplinary team was presented with many serious technical challenges that needed to be addressed expeditiously. The purpose of this paper is to examine some of the technical issues and how they were executed.

27242 (UCRL-JC–112103) **Computer vision and sensor fusion for detecting buried objects.** Clark, G.A.; Hernandez, J.E.; Sengupta, S.K.; Sherwood, R.J.; Schaich, P.C.; Buhl, M.R.; Kane, R.J.; DelGrande, N.K. Lawrence Livermore National Lab., CA (United States). Oct 1992. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9210231–4: 26. annual Asilomar conference on signals, systems, and computers, Pacific Grove, CA (United States), 25-30 Oct 1992). Order Number DE93012605. Source: OSTI; NTIS; GPO Dep.

Given multiple images of the surface of the earth from dual-band infrared sensors, our system fuses information from the sensors to reduce the effects of clutter and improve the ability to detect buried or surface target sites. Supervised learning pattern classifiers (including neural networks,) are used. We present results of experiments to detect buried land mines from real data, and evaluate the usefulness of fusing information from multiple sensor types. The novelty of the work lies mostly in the combination of the algorithms and their application to the very important and currently unsolved problem of detecting buried land mines from an airborne standoff platform.

27243 (UCRL-JC–112250) **Captive flight testing of a kinetic kill vehicle.** Worrell, R.H. (Strategic Defense Initiative Organization, Washington, DC (United States)); Summers, M.A.; Brugman, V.P.; Weaver, L.F.; Etter, J.R.; Patz, B.J.; Ruiz, Y.V. Lawrence Livermore National Lab., CA (United States). 2 Feb 1993. 27p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9302121–1: American astronomical conference, Keystone, CO (United States), 6 Feb 1993). Order Number DE93014428. Source: OSTI; NTIS; GPO Dep.

An experimental approach for the captive flight ground-testing of a prototypical exoatmospheric kinetic kill vehicle is described. The primary objective of the test is to evaluate target tracking and intercept guidance control algorithms. Test hardware is described, including the vehicle; the suspension, launch, and recovery systems; the hyper-velocity target simulator; and the diagnostics systems. Initial test results are reported.

4501 Chemical Explosions and Explosives

Refer also to citation(s) 25760, 26867, 26890, 27257, 27367

27244 (LA-UR–93-1421) **Equation of state for detonation products.** Davis, W.C. Los Alamos National Lab., NM (United States). [1993]. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930713–8: 10. detonation symposium, Boston, MA (United States), 12-16 Jul 1993). Order Number DE93012671. Source: OSTI; NTIS; GPO Dep.

An equation of state for detonation products, with the usual form $p = p(v,E)$, is proposed. It allows independent calibration of the adiabatic gamma and the Grueneisen gamma, and gives them forms in agreement with recent theoretical studies. The equation of state is given by $p = E/v[k - 1 + F(v) \{1 + b(1 - E/E^s(v))\}]$ where $F(v)$ drops from a finite value at small v to zero at large v, b is a constant, and $E^s(v)$ is the specific internal energy on the principal isentrope. Its relationship to the polytropic gas equation of state p

= $(E/v)(\gamma - 1)$ is easily seen, and it reduces to this form at large volume.

27245 (LA-UR–93-1545) **Detonation reaction steps frozen by free expansion and analyzed by mass spectrometry.** Greiner, N.R.; Fry, H.A.; Blais, N.C.; Engelke, R.P. Los Alamos National Lab., NM (United States). [1993]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930713–7: 10. detonation symposium, Boston, MA (United States), 12-16 Jul 1993). Order Number DE93012734. Source: OSTI; NTIS; GPO Dep.

Detonation reactions in small pellets of explosive are frozen by free expansion into a large vacuum chamber and analyzed by time-of-flight mass spectrometry. Sensitive explosives like PETN, RDX, and HMX show rapidly evolving reaction zones and mostly simple products like H_2O, CO, N_2, and CO_2. Less sensitive explosives like TATB, HNS, and TNT show slower evolution of the reaction zone, and more complex products in addition to the simple ones seen in PETN. Isotopic substitution shows that the more complex products contain moderate amounts of NH_3, HCN, NO, HNCO, and NO_2. Other observations include polymerization of aromatic explosive molecules, adducts to the explosive molecules, and explosive molecules with functional groups missing. The more complex products are reservoirs of unreleased energy that may affect performance.

27246 (SAND–92-1910C) **A new look at the run distance correlation and its relationship to other non-steady-state phenomena.** Cooper, P.W. Sandia National Labs., Albuquerque, NM (United States). [1992]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-930713–17: 10. detonation symposium, Boston, MA (United States), 12-16 Jul 1993). Order Number DE93014991. Source: OSTI; NTIS; GPO Dep.

A review of a portion of the published data on run distance versus input shock pressure led to the formulation of a simple single constant correlation equation: $P^2X = \alpha$. This equation can be used in lieu of the now traditional "Pop-Plot" equation. The advantages provided by this simple form are that "a" is now a quantitative single valued parameter which describes an explosive's shock sensitivity. It also allows for direct correlation to other non-steady-state phenomena such as the critical energy fluence for initiation, the detonation velocity-charge radius effect and the critical or failure diameter.

27247 (UCRL-CR–107172) **Comparison of HOB curves for 0.5-g NP charges with field test data and calculations.** Reichenbach, H. (Fraunhofer-Institut fuer Kurzzeitdynamik - Ernst-Mach-Institut (EMI), Freiburg im Breisgau (Germany)); Scheklinksi-Glueck, G.; Kuhl, A.L. Lawrence Livermore National Lab., CA (United States); Defense Nuclear Agency, Alexandria, VA (United States); Fraunhofer-Institut fuer Kurzzeitdynamik - Ernst-Mach-Institut (EMI), Freiburg im Breisgau (Germany); Logicon R and D Associates, Los Angeles, CA (United States). 31 Aug 1991. 83p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract W-7405-ENG-48. Contract DNA001-88-C-0046. (RDA-TR–0263229003-001;DNA-TR–90-223). Order Number DE93015009. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Experiments are described on the reflection of spherical blast waves from planar surfaces. The blast waves were created by the detonation of 0.5-g spherical charges of NITROPENTA (NP). The scale of the experiments was about 1/1,000 per kiloton. Diagnostics included schlieren photography and a high-speed pressure measurement system. A parametric series of height-of-burst (HOB) experiments were conducted over hydrodynamically smooth, rough and porous surfaces. Peak pressure measurements were used to construct isobaric HOB curves. The NP curves agree with the HOB curves derived from field tests that utilized much larger HE charges (1 to 500 kg). Nevertheless, comparison with high-fidelity pressure measurements from point-explosion tests and recent hydrocode simulations of the same tests has demonstrated that peak pressures on the NP experiments are about 20% too low in the low-pressure transition region – due to gauge-size limitations. The wave-forms become extremely peaked in this transition region, and gauges with better frequency response are needed to accurately measure the peak pressures.

27248 (UCRL-JC–113577) **Minimization of mixed waste in explosive testing operations.** Gonzalez, M.A.; Sator, F.E.; Simmons, L.F. Lawrence Livermore National Lab., CA (United States). Feb 1993. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-930873–1: 2. international mixed waste symposium, Baltimore, MD (United States), 17-20 Aug 1993). Order Number DE93012316. Source: OSTI; NTIS; INIS; GPO Dep.

In the 1970s and 1980s, efforts to manage mixed waste and reduce pollution focused largely on post-process measures. In the late 1980s, the approach to waste management and pollution control changed, focusing on minimization and prevention rather than abatement, treatment, and disposal. The new approach, and the formulated guidance from the US Department of Energy, was to take all necessary measures to minimize waste and prevent the release of pollutants to the environment. Two measures emphasized in particular were source reduction (reducing the volume and toxicity of the waste source) and recycling. In 1988, a waste minimization and pollution prevention program was initiated at Site 300, where the Lawrence Livermore National Laboratory (LLNL) conducts explosives testing. LLNL's Defense Systems/Nuclear Design (DS/ND) Program has adopted a variety of conservation techniques to minimize waste generation and cut disposal costs associated with ongoing operations. The techniques include minimizing the generation of depleted uranium and lead mixed waste through inventory control and material substitution measures and through developing a management system to recycle surplus explosives. The changes implemented have reduced annual mixed waste volumes by more than 95% and reduced overall radioactive waste generation (low-level and mixed) by more than 75%. The measures employed were cost-effective and easily implemented.

4502 Nuclear Explosions and Explosives

Refer also to citation(s) 25633, 25634, 25635, 26314, 26327, 26328, 27394

27249 (SAND–93-0094) **Rapid deployment access delay system (RAPADS).** Linker, K.L. Sandia National Labs., Albuquerque, NM (United States). May 1993. 22p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93015081. Source: OSTI; NTIS (US Sales Only); GPO Dep.

A rapid deployment access delay system (RAPADS) has been designed to provide high security protection of valued assets. The system is a vault enclosure that is transportable, modular, and utilizes a pin connection design to attach wall panels together for quick assembly and disassembly. Because of the unique pin connection and overlapping joint arrangement of the wall panels it is possible to construct vaults of various sizes to meet a specific application. In addition, a sequence of assembly steps are required for assembly. As a result, once the door is closed and locked, all pin connections are concealed and inaccessible, providing a high level of protection found only in some permanent vault structures. This report presents the RAPADS concept, design detail highlights, prototype fabrication, and prototype assembly. The RAPADS is readily adaptable to many applications, besides the physical protection of nuclear weapons. These include: protection of sensitive material for government agencies; the protection of weapons, evidence, and documents for drug and law enforcement agencies; and the protection of business property, equipment, and documents in the commercial sector.

27250 (SR/H–542) **[The Hanford Story, Introduction, Chapters 7, 8].** [Plant histories]. Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). [1947]. 236p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. Order Number DE93013443. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The historical documentary on the history of the Hanford Nuclear Reservation is designed to enlighten audiences on the role of Hanford in the development of the atomic weapon during World War II,

a contribution which led to its continued role in the forefront of nuclear research and development.

27251 (SR/H–566) **[The Hanford story, Chapter 17].** [Plant Histories]. Hanford Engineer Works, Richland, WA (United States). [1943]. 46p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. Order Number DE93014699. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document, Chapter 17 of "The Hanford Story" describes the research, development, and design efforts involved in the production of plutonium. The technical problems involved in pile design and development and the methods for chemical separation of plutonium from the parent uranium and fission products are discussed.

27252 (SR/H–567) **[The Hanford story, Chapter 18].** [Plant Histories]. Hanford Engineer Works, Richland, WA (United States). [1943]. 74p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. Order Number DE93014700. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document, Chapter 18 of "The Hanford Story" presents a discussion of the construction and operation of the plutonium production plants.

27253 (SR/H–568) **[The Hanford story, Chapter 19].** [Plant Histories]. Hanford Engineer Works, Richland, WA (United States). [1943]. 69p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. Order Number DE93014701. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document, Chapter 19 of "The Hanford Story" describes the health and safety programs at the facilities involved in the plutonium production processes.

27254 (SR/H–574) **Plant history: The Hanford story, Chapter 22.** Hanford Engineer Works, Richland, WA (United States). [1945]. 40p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. Order Number DE93015171. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document, Chapter 22 of "The Hanford Story" provides a discussion of the foreign intelligence and security problems associated with the Manhattan Project.

27255 (SR/H–576) **[The Hanford story, chapter 20].** [Plant History]. Du Pont de Nemours (E.I.) and Co., Aiken, SC (United States). Savannah River Plant. [1945]. 73p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. Order Number DE93015173. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document, Chapter 20 of "The Hanford Story" details the planning, construction, development, and management of the "Atomic Communities" of Oak Ridge, Tennessee; Richland, Washington; and Los Alamos, New Mexico as part of the Plutonium production process.

27256 (SR/H–577) **[The Hanford story, Chapter 21].** [Plant Histories]. Hanford Engineer Works, Richland, WA (United States). [1943]. 90p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. Order Number DE93015174. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document, Chapter 21 of "The Hanford Story" provides a discussion of the production and testing of the atomic bomb. Construction, personnel, and management of the community and laboratories of Los Alamos are discussed.

27257 (UCRL-JC–113056) **Planning and preliminary design of a contained firing chamber to resist blast effects of 60kg of energetic chemical explosive.** Pastrnak, J.W.; Baker, C.F.; Simmons, L.F. Lawrence Livermore National Lab., CA (United States). Feb 1993. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-930681–1: 24. international annual conference of the Fraunhofer Institute of Chemical Technologies, Karlsruhe (Germany), 29 Jun - 2 jul 1993). Order Number DE93014654. Source: OSTI; NTIS; GPO Dep.

The Lawrence Livermore National Laboratory (LLNL) Nuclear Weapons Design Program operates explosive testing facilities at its Site 300 open air explosive test facility. LLNL is developing a blast containment facility to reduce emissions of hazardous materials and reduce the amount of contaminated waste generated from explosive testing of chemical explosives. The firing chamber is designed to contain the blast over pressure and fragment effects from detonations of cased explosive charges up to 60kg of PBX-94042 or an equivalent TNT[3] design weight of 206 lbs. The inside walls of the chamber are protected from high velocity fragments from cased explosive detonations. All structural elements of the firing chamber are designed to remain elastic when subjected to blast to permit repetitive firings. The firing chamber is designed to minimize the release of hazardous material to the environment with a goal of near zero discharge. The objective of this project is to e hazardous emissions to the environment, reduce quantities of hazardous waste, and to provide a continuing capability to test high explosives. We believe this project will be the pace setter in the area of explosive testing technology.

4503 Nuclear Explosion Detection

27258 (LA-UR–92-4409) **Integrated Verification Experiment data collected as part of the Los Alamos National Laboratory's Source Region Program: Appendix C, Infrasonic measurements of IVE events: Los Alamos Source Region Program.** Whitaker, R.W.; Noel, S.D. Los Alamos National Lab., NM (United States). Dec 1992. 39p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93015856. Source: OSTI; NTIS; GPO Dep.

The summary report by Tom Weaver gives the overall background for the series of IVE (Integrated Verification Experiment) experiments including information on the full set of measurements made. This appendix presents details of the infrasound data for the and discusses certain aspects of a few special experiments. Prior to FY90, the emphasis of the Infrasound Program was on underground nuclear test (UGT) detection and yield estimation. During this time the Infrasound Program was a separate program at Los Alamos, and it was suggested to DOE/OAC that a regional infrasound network be established around NTS. The IVE experiments took place in a time frame that allowed simultaneous testing of possible network sites and examination of propagation in different directions. Whenever possible, infrasound stations were combined with seismic stations so that a large number could be efficiently fielded. The regional infrasound network was not pursued by DOE, as world events began to change the direction of verification toward non-proliferation. Starting in FY90 the infrasound activity became part of the Source Region Program which has a goal of understanding how energy is transported from the UGT to a variety of measurement locations.

27259 (LA-UR–93-861) **Ground motions and the infrasound signal: A new model and the discovery of a significant cavity rebound signal: Los Alamos Source Region Program.** Jones, E.M.; App, F.N.; Whitaker, R.W. Los Alamos National Lab., NM (United States). Mar 1993. 31p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93015858. Source: OSTI; NTIS; GPO Dep.

A model is presented that relates infrasound signals from underground nuclear tests to the peak vertical velocity at surface-ground-zero. For the most part, agreement between the model and observations is good, the exceptions being events conducted in shallow tuff layers in Yucca Flat. These events all have low values of the peak surface velocity. The authors have determined that the lack of agreement for these events is due to an unusual, second spall event. A stress-wave calculation is presented that reproduces the second-spall phenomenon and indicates that it is due to interference of cavity-rebound-associated signal with the initial ballistic motion of the surface layers. The effect of the rebound signal is to increase the amplitude of the infrasound signal and thus make low velocity events more detectable.

27260 (LA-UR–93-1615) **Modelling of nuclear explosions in hard rock sites.** Brunish, W.M.; App, F.N. Los Alamos National Lab., NM (United States). [1993]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930397–2: Numerical modeling for underground nuclear test monitoring symposium, Durango, CO (United States), 23-25 Mar 1993). Order Number DE93012714. Source: OSTI; NTIS; INIS; GPO Dep.

This study represents part of a larger effort to systematically model the effects of differing source region properties on ground motion from underground nuclear explosions at the Nevada Test Site. In previous work by the authors the primary emphasis was on alluvium and both saturated and unsaturated tuff. We have attempted to model events on Pahute Mesa, where either the working point medium, or some of the layers above the working point, or both, are hard rock. The complex layering at these sites, however, has prevented us from drawing unambiguous conclusions about modelling hard rock. In order to learn more about the response of hard rock to underground nuclear explosions, we have attempted to model the PILEDRIVER event. PILEDRIVER was fired on June 2, 1966 in the granite stock of Area 15 at the Nevada Test Site. The working point was at a depth of 462.7 m and the yield was determined to be 61 kt. Numerous surface, sub-surface and free-field measurements were made and analyzed by SRI. An attempt was made to determine the contribution of spall to the teleseismic signal, but proved unsuccessful because most of the data from below-shot-level gauges was lost. Nonetheless, there is quite a bit of good quality data from a variety of locations. We have been able to obtain relatively good agreement with the experimental PILEDRIVER waveforms. In order to do so, we had to model the granodiorite as being considerably weaker than "good quality" granite, and it had to undergo considerable weakening due to shock damage as well. In addition, the near-surface layers had to be modeled as being weak and compressible and as have a much lower sound speed than the material at depth. The is consistent with a fractured and jointed material at depth, and a weathered material near the surface.

27261 (LA-UR-93-1699) **Experimental and theoretical studies of spectral alteration in ultrasonic waves resulting from nonlinear elastic response in rock.** Johnson, P.A.; McCall, K.R.; Meegan, G.D. Jr. Los Alamos National Lab., NM (United States). 1993. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930397-3: Numerical modeling for underground nuclear test monitoring symposium, Durango, CO (United States), 23-25 Mar 1993). Order Number DE93014432. Source: OSTI; NTIS; GPO Dep.

Experiments in rock show a large nonlinear elastic wave response, far greater than that of gases, liquids and most other solids. The large response is attributed to structural defects in rock including microcracks and grain boundaries. In the earth, a large nonlinear response may be responsible for significant spectral alteration at amplitudes and distances currently considered to be well within the linear elastic regime.

4505 Strategic Defense Initiative

Refer also to citation(s) 26384

27262 (ANL/EP/CP-79689) **Commissioning status of the Continuous Wave Deuterium Demonstrator.** Hartog, P.D. (Grumman Aerospace Corp., Bethpage, NY (United States)); Dooling, J.; Lorello, M.; Rathke, J.; Carwardine, J.; Godden, D.; Pile, G.; Yule, T.; Zinneman, T. Argonne National Lab., IL (United States). [1993]. 4p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-930511-156: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014917. Source: OSTI; NTIS; GPO Dep.

Grumman Aerospace Corporation, Argonne National Laboratory, and Culham Laboratory are commissioning the Continuous Wave Deuterium Demonstrator (CWDD) in a facility at Argonne National Laboratory. CWDD is a high-brightness, high-current, 7.5-MeV negative deuterium accelerator. The 352-MHz rf accelerating cavities are cryogenically cooled with supercritical neon to reduce the rf power requirements. Installation of the accelerator into the Argonne facility began in May 1991, and first beam from the injector was extracted in February 1992. The accelerator and facility are described, and current status and future plans are discussed.

27263 (LA-12442-MS) **Active defenses: Status and issues.** Canavan, G.H. Los Alamos National Lab., NM (United States). Mar 1993. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93013597. Source: OSTI; NTIS; GPO Dep.

Active defenses should logically be an integral part of future US force structures. In the near term they can defend US expeditionary forces, friends, and Allies. In the mid-term they will address accidental and unauthorized launch threats that already exist due to the missile forces of the Former Soviet Union/Republics and those evolving from the possession of missiles and weapons of mass destruction (WMD) by third-world countries. In the long term they could support the integration of strategic offensive and defensive forces to address the more deliberate attacks that might evolve on that time scale. Throughout, they could support measures to dealert and disengage strategic forces and help monitor their results.

27264 (UCRL-JC-110273) **Spacecraft fabrication and test integration: Leveraging existing information.** Sanders, D. (Lawrence Livermore National Lab., CA (United States)); Storch, N.; Sharick, T.; LeClair, S. Lawrence Livermore National Lab., CA (United States). Apr 1992. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9204112-3: 2. small satellite technology and applications, Orlando, FL (United States), 20-24 Apr 1992). Order Number DE93012483. Source: OSTI; NTIS; GPO Dep.

The Automated Spacecraft Assembly Project (ASAP) or Manufacturing Operations Development and Integration Laboratories (MODIL) thrust is studying the potential for leveraging "soft" (computer-based) technologies in spacecraft manufacturing, because above-the-shop-floor costs typically account for 40 to 70% of the total costs of manufacturing. Our preliminary survey of soft technologies of above-the-shop-floor operations identified the areas which show the greatest potential benefit in cost and time savings for SDIO spacecraft fabrication and test. The preliminary survey reviewed initiatives from CALS, DARPA, ManTech, industry and SDIO. Three key areas with the greatest the potential benefits are: (1) enabling and re-engineering interactions between members of a conceptual "extended partnership organization" of System Program Office (SPO), prime contractors, sub-contractors and suppliers which produce an SDI system; (2) enabling computer supported inter-enterprise interactions; and (3) implementing integrated product development (IPD) programs for each SDI system. We propose initiatives to address all of these, including a roadmap to put high quality IPD in place in one SDI system, and then transfer the technology to all willing prime contractors and other SDI systems.

4506 Chemical and Biological

Refer also to citation(s) 26893

27265 (PNL-8651) **An assessment of nondestructive testing technologies for chemical weapons monitoring.** Taylor, T.T. Pacific Northwest Lab., Richland, WA (United States). May 1993. 128p. Sponsored by USDOE, Washington, DC (United States); Department of Defense, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93014148. Source: OSTI; NTIS; GPO Dep.

The US Department of Energy (DOE), with the US Army Chemical Research, Development and Engineering Center (CRDEC) under the sponsorship of the Defense Nuclear Agency (DNA), completed testing of Nondestructive Evaluation (NDE) technology on live agent systems. The tests were conducted at Tooele Army Depot during August 1992. The Nondestructive Evaluation systems were tested for potential use in verifying chemical treaty requirements. Five technologies, two neutron and three acoustic, were developed at DOE laboratories. Two systems from the United Kingdom (one neutron and one acoustic) were also included in the field trials. All systems tested showed the ability to distinguish among the VX, GB, and Mustard. Three of the systems (two acoustic and one neutron) were used by On-Site Inspection Agency (OSIA) personnel.

54 ENVIRONMENTAL SCIENCES

Refer also to citation(s) 25855, 27365

27266 (IEE-SR–238) **Environmental protection movements seen in American societies.: With educational and enlightening activities as main theme.** Institute of Energy Economics, Tokyo (Japan). 1 Mar 1993. 57p. (In Japanese). Order Number DE93798920. Source: OSTI; NTIS; Available from The Institute of Energy Economics, Dai 10 Mori Biru, 18-1, Toranomon 1-chome, Minato-ku, Tokyo, Japan.

This paper reports environmental protection movements seen in the American societies. The report consists mainly of a brief history of the American environmental protection movements and an on-site report on an environmental education summer camp. The environmental protection movements in the U.S.A. have been developing with the Nature Protection Movement (a non-governmental organization) as a base organization. The American environmental education has taken deep roots in people's life. Observing the nation's schooling systems, the social education systems, and the life styles leads to an awareness that such educational infrastructures are all well adjusted to promoting the environmental education. After outlining these American environmental education infrastructures, including a Japan-U.S. comparison, the present paper gives an on-site report of an environmental education summer camp. The National Wildlife Federation (NWF) holds summer camps intended mainly for environmental education and nature observation, where children are educated on environments while communing with nature. The American environmental protection movements with a history of more than 100 years are characterized by having taken roots in people's daily life since their childhood. 21 refs., 18 figs., 13 tabs.

27267 (NEI-DK–1222) **National Environmental Research Institute R and D projects 1993.** Danmarks Miljoeundersoegelser, Roskilde (Denmark). Apr 1993. 114 p.p. Order Number DE93500313. Source: OSTI; NTIS.

The publication provides detailed information on the current research activities of the National Environmental Research Institute (Denmark). NERI operates under the Danish Ministry of the Environment with the task of carrying out both strategic and applied research, and is responsible for the collection and the overall management and coordination of data on nature and the environment. The institute is also committed to providing the environmental authorities with extensive guidance and professional support. The scope of research is very broad, covering science, technology and also the social sciences. The institute firmly believes that environmental problems demand intensive interdisciplinary and trans-boundary research cooperation and invites comments on its line of research and offers of collaboration. Research areas of the described projects are divided under the headings of systems analysis, microbiology, ecotoxilogy, environmental and analytical chemistry, atmospheric research, arable land ecology, uncultivated areas and woodlands, lake-, estaurine-, marine- and population-ecology and environmental data management. Project descriptions include the names of the project coordinator and of the scientists involved in the research and the number of personnel involved during the year. Collaborating institutions are mentioned by name in addition to external sponsoring agencies and foundations. Descriptions are given of the project's objectives and the methods or line of action adopted for carrying out the research. The aims, structure and management of the National Environmental Institute are described. (AB).

27268 (PNL-SA–22693) **Computing & Information Sciences.** Dunning, T.H. Jr.; Lewis, J.R. Pacific Northwest Lab., Richland, WA (United States). Jun 1993. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93017149. Source: OSTI; NTIS; GPO Dep.

Computing is an integral part of the research being conducted by scientists in the Molecular Sciences Research Center at Pacific Northwest Laboratory. The advanced computing infrastructure for the Computing and Information Sciences (C&IS) program of the Environmental and Molecular Sciences Laboratory will provide a state-of-the-art facility where scientific research can be performed to support US Department of Energy missions in environmental restoration and waste management, energy and environmental quality, and science and technology. The C&IS program is composed of five research and applied development facilities: High Performance Computing, Data Management and Archiving, Graphics and Visualization, Distributed Computing, Network Infrastructure, and Computer Instrumentation and Electronics. This report briefly describes the programs of these five facilities.

5401 Environmental Sciences, Atmospheric

Refer also to citation(s) 25554, 25555, 25578, 25588, 25620, 25703, 25760, 25761, 25848, 26059, 26112, 26273, 26427, 26429, 26430, 26431, 26432, 26433, 26434, 26518, 26528, 26561, 26562, 26852, 26942, 26973, 27383, 27387, 27400, 27429, 27433, 27437, 27439, 27443, 27444, 27445, 27450, 27477, 27505, 27611, 27634, 27645, 27669, 28143

27269 (ANL/EAIS/CP–78850) **AQUIS: A PC-based source information manager.** Smith, A.E. (Argonne National Lab., IL (United States). Environmental Assessment and Information Sciences Div.); Huber, C.C.; Tschanz, J.; Ryckman, S.J. Jr. Argonne National Lab., IL (United States). Environmental Assessment and Information Sciences Div. [1993]. 10p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-930647–3: 86. annual meeting and exhibition of the Air and Waste Management Association, Denver, CO (United States), 13-18 Jun 1993). Order Number DE93012893. Source: OSTI; NTIS; GPO Dep.

The Air Quality Utility Information System (AQUIS) was developed to calculate emissions and track them along with related information about sources, stacks, controls, and permits. The system runs on IBM- compatible personal computers with dBASE IV and tracks more than 1, 200 data items distributed among various source categories. AQUIS is currently operating at 11 US Air Force facilities, which have up to 1, 000 sources, and two headquarters. The system provides a flexible reporting capability that permits users who are unfamiliar with database structure to design and prepare reports containing user- specified information. In addition to the criteria pollutants, AQUIS calculates compound-specific emissions and allows users to enter their own emission estimates.

27270 (ANL/EAIS/TM–86) **Environmental assessment for the Atmospheric Radiation Measurement (ARM) Program: Southern Great Plains Cloud and Radiation Testbed (CART) site.** Policastro, A.J.; Pfingston, J.M.; Maloney, D.M.; Wasmer, F.; Pentecost, E.D. Argonne National Lab., IL (United States). Environmental Assessment and Information Sciences Div. Mar 1992. 223p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (DOE/EA–0680). Order Number DE93009439. Source: OSTI; NTIS; INIS; GPO Dep.

The Atmospheric Radiation Measurement (ARM) Program is aimed at supplying improved predictive capability of climate change, particularly the prediction of cloud-climate feedback. The objective will be achieved by measuring the atmospheric radiation and physical and meteorological quantities that control solar radiation in the earth's atmosphere and using this information to test global climate and related models. The proposed action is to construct and operate a Cloud and Radiation Testbed (CART) research site in the southern Great Plains as part of the Department of Energy's Atmospheric Radiation Measurement Program whose objective is to develop an improved predictive capability of global climate change. The purpose of this CART research site in southern Kansas and northern Oklahoma would be to collect meteorological and other scientific information to better characterize the processes controlling radiation transfer on a global scale. Impacts which could result from this facility are described.

27271 (BNL–48499) **An assessment of acid fog.** Lipfert, F.W. Brookhaven National Lab., Upton, NY (United States). [1992]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-920556–1: International symposium on measurement of toxic and related air pollutants, Durham, NC (United States), 4-8 May 1992). Order Number DE93009347. Source: OSTI; NTIS; INIS; GPO Dep.

Airborne particles have long been associated with adverse effects on public health, begin with the notorious air pollution disasters of several decades ago. Although H_2SO_4 was identified early

on as a potential causal factors during these episodes (in part because of concern for potential health effects of particle acidity per se has intensified only recently. Most of the recent aerometric research in the US on acid fog has focused on the ability of clouds and fog to deliver acidity to vegetation and ecosystems. Strong acids are characterized chemically by their pH or H^+ concentration. For fog, concentrations are referred to the droplet liquid content; for other (i.e., "clear air") aerosols, to the volume of air sampled. A useful measure of the relationship between aerosol and fog is obtained by comparing their mass concentrations on the basis of the same volume of air, by multiplying fogwater concentrations by liquid water content (LWC). This paper reviews fog measurement capability, physical properties and chemistry, and presents a simple urban airshed model which is used to simulate the evolution of fog and aerosol concentrations under urban stagnation conditions.

27272 (BNL–48755) **New York MARKAL: An evaluation of carbon dioxide emission control strategies in New York State.** Hamilton, L.D. Brookhaven National Lab., Upton, NY (United States). [1992]. 11p. Sponsored by Environmental Protection Agency, Washington, DC (United States); Empire State Electric Energy Research Corp., New York, NY (United States); New York State Energy Research and Development Authority, Albany, NY (United States). DOE Contract AC02-76CH00016. (CONF-9201150–1: International CHALLENGE symposium, Laxenburg (Austria), 30-31 Jan 1992). Order Number DE93013149. Source: OSTI; NTIS; INIS; GPO Dep.

A MARKAL model was developed for the State of New York. It represents the State's energy system as a set of typical technologies for generating, converting, and using energy as it evolves over a 45-year period. NYMARKAL was applied here in demonstration analyses to explore strategies to reduce CO2 emissions. NYMARKAL was installed at the State Energy Office and in the Offices of the New York Power Pool. Example scenarios showed that it is more difficult and more expensive to reduce carbon emissions in New York State than in the United States as a whole. Were a common carbon tax instituted, it would have less effect in New York and most carbon emissions reduction would take place elsewhere in the country where it is more cost-effective. Alternatively, were all states required to reduce CO2 emission an equal percentage (say by 20%), the cost per unit emissions reduction to New York would be much greater than in the rest of the country.

27273 (BNL–70039) **[Travel to Russia to define research needs to improve description of cloud processes influencing atmospheric transport and transformation of pollutants]: Foreign trip report, September 28–October 5, 1991.** Schwartz, S.E. Brookhaven National Lab., Upton, NY (United States). 17 Oct 1991. 54p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. Order Number DE93011246. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The traveler participated in the World Meteorological Organization (WMO) Meeting of Experts on the Role of Cloud Chemistry in Transformation and Transport of Air Pollutants. The purpose of the Workshop was to define research needs to improve description of cloud processes influencing atmospheric transport and transformation of pollutants, specifically including energy related pollutants. Traveler was co-chair of the microscale processes working group. A draft report was prepared; after editing, the report will be issued by WMO. The report identifies key research needs and suggests approaches, including acquisition of a greatly enhanced data base of measurements of cloud composition, development of a state-of-the-science community cloud chemistry model, and conduct of a series of international field experiments addressing clouds and cloud chemical processes. Traveler also visited the Institute of Experimental Meteorology at Obninsk, including its unique 3200 cubic meter cloud chamber and 330 meter meteorological tower.

27274 (BNL–70157) **Travel to England for meeting on Global Environmental Change: Foreign trip report, June 2, 1992–June 6, 1992.** Long, S.P. Brookhaven National Lab., Upton, NY (United States). 24 Jun 1992. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. Order Number DE93011059. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The traveler participated in the UK Research Councils' meeting on support for Global Environmental Change. Specifically to evaluate grant applications under the AFRC Program on Biological Response to Global Environmental Change, to discuss a joint research councils feasibility study of elevated CO_2 experimental facilities (relevant to BNL's research on the effects of rising CO_2 concentrations on vegetation), to discuss the development of a UK initiative on the responses of ecosystems to rising UV-B irradiation, and to discuss integration with the NERC TIGER initiative.

27275 (BNL–70276) **[Greenhouse gases and national energy options]: Foreign travel trip report, October 24–November 4, 1992.** Hamilton, L.D.; Morris, S.C.; Goldstein, G.A. Brookhaven National Lab., Upton, NY (United States). 20 Nov 1992. 58p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. Order Number DE93008862. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The purpose of the trip was to attend and give essential presentations at the International Energy Agency (IEA), Energy Technology Systems Analysis Project (ETSAP) Annex IV, Greenhouse Gases and National Energy Options: Technologies and Costs for Reducing Emissions of Greenhouse Gases, 6th Workshop at ENEA, Rome, Italy (October 26-29, 1992) (LDH/SCM/GAG). In addition, Dr. L. D. Hamilton to act as US Department of Energy Representative at 6th Workshop and 6th Executive Committee Meeting of ETSAP Annex IV (October 30, 1992) (LDH/GAG) and to visit the Division of Envirorunental Health (WHO) HQ, Geneva, Switzerland (October 31 - November 3, 1992) (LDH). The travelers' role focused on the use of MARKAL and MARKAL-MACRO in analyses focussed on, strategies to reduce greenhouse gas emissions from energy systems.

27276 (CONF-9110336–, pp. 1-5) **A study of longwave radiation codes for climate studies: Validation with ARM observations and tests in general circulation models.** Ellingson, R.G. (Univ. of Maryland, College Park (US)); Baer, F. USDOE Office of Energy Research, Washington, DC (United States). Environmental Sciences Div. Dec 1992. From 2. Atmospheric Radiation Measurement (ARM) science team meeting; Denver, CO (United States); 26-30 Oct 1991. In *Proceedings of the second Atmospheric Radiation Measurement (ARM) Science Team Meeting.* 169p. Order Number DE93005886. Source: OSTI; NTIS; INIS.

One specific goal of the Atmospheric Radiation Measurement Program (ARM) is to improve the treatment of radiative transfer in general circulation models (GCM) under clear-sky, general overcast, and broken cloud conditions. We plan to contribute to this goal by attacking major problems connected with one of the dominant radiation components of the problem-longwave radiation. In particular, our long-term research goals are to: develop an optimum longwave radiation model for use in GCMs that has been calibrated with state-of-the-art observations; assess the impact of the longwave radiative forcing in a GCM; determine the GCM's sensitivity to the radiative model used in it; and determine how the longwave radiative forcing contributes relatively when compared with shortwave radiative forcing, sensible heating, thermal advection, and expansion. Our approach to developing the radiation model will be to test existing models in an iterative, predictive fashion. We will supply the Clouds and Radiative Testbed (CART) with a set of models to be compared with operationally observed data. The differences we find will lead to the development of new models to be tested with new data. Similarly, our GCM studies will use existing GCMs to study the radiation sensitivity problem. We anticipate that the out come of this approach will provide both a better longwave radiative forcing algorithm and a better understanding of how longwave radiative forcing influences the equilibrium climate of the atmosphere.

27277 (CONF-9110336–, pp. 7-10) **Absorption coefficients of CFC-11, CFC-12, HCFC-22, and SF_6 relevant to atmospheric remote sensing and global warming studies.** Varanasi, P. (State Univ. of New York, Stony Brook (US)). USDOE Office of Energy Research, Washington, DC (United States). Environmental Sciences Div. Dec 1992. From 2. Atmospheric Radiation Measurement (ARM) science team meeting; Denver, CO (United States);

26-30 Oct 1991. In *Proceedings of the second Atmospheric Radiation Measurement (ARM) Science Team Meeting.* 169p. Order Number DE93005886. Source: OSTI; NTIS; INIS.

Spectral absorption coefficients (or absorption cross-sections) K_v, ($cm^{-1}atm^{-1}$) of CFC-11, CFC-12, HCFC-12, and SF. have been measured in the spectral region (8-12 μm) known as the 'atmospheric window.' Data obtained with a grating spectrometer, which has wide spectral coverage and adequate spectral resolution (0.4 cm^{-1}), for CFC-11, CFC-12, and HCFC-12 are not presented here but can be obtained from the author. We have also measured at various temperature-pressure combinations, which are chosen to represent tangent heights (as in solar-occultation experiments) or layers in the atmosphere, the K_v of CFC-12 in the 921 and 923 cm^{-1} Q-branches, of HCFC-22 in the 829 cm^{-1} Q-branch, and of SF_6, in the 947.9 cm^{-1} Q-branch with the Doppler-limited spectral resolution ($\sim 10^{-4}$ CM^{-1}) of a tunable diode laser spectrometer. The latter is especially suited for atmospheric remote sensing, while the grating spectra are useful in global warming studies.

27278 (CONF-9110336–, pp. 11-13) **Spectroscopic study of water vapor absorption in the 8- to 14-μm atmospheric window: Measurement of new line and continuum parameters and investigation of far-wind phenomena.** Kulp, T.J. (Lawrence Livermore National Lab., CA (US)); Shinn, J. USDOE Office of Energy Research, Washington, DC (United States). Environmental Sciences Div. Dec 1992. From 2. Atmospheric Radiation Measurement (ARM) science team meeting; Denver, CO (United States); 26-30 Oct 1991. In *Proceedings of the second Atmospheric Radiation Measurement (ARM) Science Team Meeting.* 169p. Order Number DE93005886. Source: OSTI; NTIS; INIS.

The accurate quantitative understanding of the latent infrared (IR) absorption in the atmospheric window regions continues to be an area of research interest for the global climate modeling community. This need is particularly great in the 8- to 14-μm window, which spans a large portion of the 300K blackbody emission spectrum. There, the latent absorption is caused primarily by water vapor and consists of two distinct features: (1) the weak lines originating both from transitions in the far edge of the water pure rotational band (at the long wavelength boundary of the window) and from transitions located in the trailing edge of the υ_2 rovibrational band (at the short wavelength boundary) and (2) the water vapor continuum. The data-base concerning the lines is periodically updated, yet there remain spectral gaps in which accurate laboratory measurements are required to substantiate long-path length atmospheric results. The continuum has been the subject of investigations for a number of years, both with respect to its spectral intensity as a function of temperature and pressure and with regard to its physical origins. At present, the continuum absorption near room temperature is relatively well characterized; however, the database must be expanded to span all relevant atmospheric conditions. Among the explanations proposed as causes of the continuum are the cumulative absorption of the far wings of distant lines, absorption by dimers and higher-order clusters, and higher-order linear absorption processes. A common thread among all these explanations is that the continuum absorption is somehow linked to intermolecular interactions between water molecules. The initial goals of this project are to address the gaps in the quantitative understanding of both the water vapor line and continuum in the 8- to 14-μm window. To this end, the initial year has been spent assembling the necessary equipment to make these measurements.

27279 (CONF-9110336–, pp. 15-20) **The HITRAN atmospheric molecular spectroscopic database.** Rothman, L.S. (Air Force Geophysics Lab., Hanscom AFB, MA (US)). USDOE Office of Energy Research, Washington, DC (United States). Environmental Sciences Div. Dec 1992. From 2. Atmospheric Radiation Measurement (ARM) science team meeting; Denver, CO (United States); 26-30 Oct 1991. In *Proceedings of the second Atmospheric Radiation Measurement (ARM) Science Team Meeting.* 169p. Order Number DE93005886. Source: OSTI; NTIS; INIS.

The Optical Environment Division of the Air Force Geophysics Laboratory has been engaged throughout its history in the development of computer codes and databases to facilitate spectral modeling of atmospheric transmission and radiative processes. Major updates to the computer codes have recently been made available: FASCODE3 (for high resolution line-byline calculations), LOWTRAN7 (moderate resolution band-model code), and MODTRAN (an intermediate resolution band-model code). In addition, a new edition of HITRAN, the spectroscopic molecular absorption database, has become available. HITRAN now contains greatly improved data for 30 molecular species from zero wavenumber through the visible region. There are also numerous bands of species such as the chlorofluorocarbons contained as cross-section data on the HITRAN compilation. These models and database have a significant impact on spectral simulations and remote sensing capabilities. This paper will review these recent developments and present some examples of current applications.

27280 (CONF-9110336–, pp. 21-24) **Radiative transfer model development in support of the Atmospheric Radiation Measurement (ARM) program.** Clough, S.A. (Atmospheric and Environmental Research, Inc., Cambridge, MA (US)). USDOE Office of Energy Research, Washington, DC (United States). Environmental Sciences Div. Dec 1992. From 2. Atmospheric Radiation Measurement (ARM) science team meeting; Denver, CO (United States); 26-30 Oct 1991. In *Proceedings of the second Atmospheric Radiation Measurement (ARM) Science Team Meeting.* 169p. Order Number DE93005886. Source: OSTI; NTIS; INIS.

The availability of a rapid highly accurate multiple scattering radiative transfer model is essential to meet the objectives of the Atmospheric Radiation Measurement (ARM) Program. The model must be capable of computing radiance at spectral intervals consistent with the monochromatic spectral variation of the atmospheric molecular absorption. The resolution of the spectrometers to be deployed at the ARM sites, 0.1 cm^{-1} and less, will provide an important assessment of our capability to perform radiative transfer calculations in the multiply scattered environment. A second important application for the high-accuracy high-resolution model is to provide parameterizations and validations for the faster low-resolution models required for general circulation models (GCMs). The computational cost of performing multiple scattering calculations at monochromatic resolution over broad spectral regions is extremely high. The major focus of our research effort has been directed to the development of an accelerated multiple scattering model for the longwave spectral region.

27281 (CONF-9110336–, pp. 25-27) **Treatment of cloud radiative effects in general circulation models.** Wang, W.C. (State Univ. of New York, Albany (US)); Liang, X.Z.; Dudek, M.D.; Cox, S. USDOE Office of Energy Research, Washington, DC (United States). Environmental Sciences Div. Dec 1992. From 2. Atmospheric Radiation Measurement (ARM) science team meeting; Denver, CO (United States); 26-30 Oct 1991. In *Proceedings of the second Atmospheric Radiation Measurement (ARM) Science Team Meeting.* 169p. Order Number DE93005886. Source: OSTI; NTIS; INIS.

We participate in the Atmospheric Radiation Measurement (ARM) program with two objectives: (1) to improve the general circulation model (GCM) cloud/radiation treatment with focus on cloud overlapping and the cloud optical properties and (2) to study the effects of cloud/radiation-climate interaction on climate simulations. The project includes three tasks: (1) GCM radiation model-to-observation comparison, (2) GCM radiation model development, and (3) GCM climate simulations.

27282 (CONF-9110336–, pp. 29-32) **Analysis of cloud radiative forcing and feedback in a climate general circulation model.** Lacis, A. (NASA, Goddard Space Flight Center, New York, NY (US)). USDOE Office of Energy Research, Washington, DC (United States). Environmental Sciences Div. Dec 1992. From 2. Atmospheric Radiation Measurement (ARM) science team meeting; Denver, CO (United States); 26-30 Oct 1991. In *Proceedings of the second Atmospheric Radiation Measurement (ARM) Science Team Meeting.* 169p. Order Number DE93005886. Source: OSTI; NTIS; INIS.

The overall objectives of the Atmospheric Radiation Measurement (ARM) program research at the Goddard Institute for Space Studies (GISS) are to refine and validate the GISS General Circulation Model (GCM) radiation code through model intercomparisons

and comparison with ARM observations, to refine and restructure the GISS GCM diagnostics to facilitate more informative comparisons with global radiation/cloud datasets, and to use ARM data to develop improved parameterizations of the radiative impact of clouds and to study the interaction of dynamics and radiation.

27283 (CONF-9110336–, pp. 33-34) **Atmospheric radiation measurement aerosol working group.** Penner, J.E. (Lawrence Livermore National Lab., CA (US)). USDOE Office of Energy Research, Washington, DC (United States). Environmental Sciences Div. Dec 1992. From 2. Atmospheric Radiation Measurement (ARM) science team meeting; Denver, CO (United States); 26-30 Oct 1991. In *Proceedings of the second Atmospheric Radiation Measurement (ARM) Science Team Meeting.* 169p. Order Number DE93005886. Source: OSTI; NTIS; INIS.

The stated goal of the Atmospheric Radiation Measurement (ARM) program is to improve the treatment of radiation in general circulation models (GCMs). The means for doing so will be to compare model-predicted radiative fluxes with measured fluxes at four to six permanent sites. The measured fluxes will characterize the fluxes expected on the scale of a GCM grid box. Because aerosol optical depths at solar wavelengths vary from less than 0.01 under clean oceanic conditions to about 0.5 under hazy east coast conditions, the measured fluxes will, at the very least, need to be corrected for the altered flux characteristics due to aerosols. If the anthropogenic component of aerosols is changing with time and if the anthropogenic component of aerosol optical depths is significant (as suggested in several recent papers), general circulation models must also be improved to account for these effects. Furthermore, if aerosols also affect cloud optical depths (the Twomey effect), it becomes even more important to improve the treatment of aerosols and aerosol interactions with clouds in general circulation models. The question that faces ARM program management, however, is how best to approach these needs. What recommended set of research questions can the ARM program address, given the experimental framework of instruments and science objectives? What are the recommended approaches (experimental and modeling) for addressing these research questions?

27284 (CONF-9110336–, pp. 35) **Plane-parallel albedo bias.** Cahalan, R.F. (NASA, Goddard Space Flight Center, Greenbelt, MD (US)); Wiscombe, W.J. USDOE Office of Energy Research, Washington, DC (United States). Environmental Sciences Div. Dec 1992. From 2. Atmospheric Radiation Measurement (ARM) science team meeting; Denver, CO (United States); 26-30 Oct 1991. In *Proceedings of the second Atmospheric Radiation Measurement (ARM) Science Team Meeting.* 169p. Order Number DE93005886. Source: OSTI; NTIS; INIS.

An increase in the average albedo of the Earth-atmosphere system of only 10% is potentially capable of decreasing surface temperatures below those of the last Ice Age. Nevertheless, cloud albedo biases of 10% and more would be introduced into large regions of current climate models if clouds were given their observed liquid water amounts, because of the treatment of clouds as plane-parallel. Past work has focused on the 3-D shape of clouds and its contribution to this bias. The present work ignores the shape effect and focuses instead on the effect of cloud optical depth variability within a climate model grid square. The plane-parallel approximation used in climate models such as general circulation models performs a single 1-D radiative transfer calculation for an entire grid square (consisting of many pixels), using a single pixel-averaged optical depth. In other words, the statistical variation of the optical depth within the grid square is ignored. We have found from Monte Carlo calculations that stratocumulus cloud albedo can often be treated in the "independent-pixel approximation," whereby, for radiative purposes, each cloud pixel is treated as 1-D. Basically, this finding means that inter-pixel variations in optical properties are often mild enough that whatever inter-pixel communication exists is, statistically speaking, nearly neutral (it is exactly neutral in a pure plane-parallel cloud). Unlike the plane-parallel approximation, the independent-pixel approximation considers the statistical variations of the optical depth within the grid square, but ignores imbalances in inter-pixel photon exchange.

27285 (CONF-9110336–, pp. 37-38) **A stochastic formulation of radiative transfer in clouds and radiative properties of non-uniform clouds.** Stephens, G.L. (Colorado State Univ., Ft. Collins (US)); Gabriel, P.D. USDOE Office of Energy Research, Washington, DC (United States). Environmental Sciences Div. Dec 1992. From 2. Atmospheric Radiation Measurement (ARM) science team meeting; Denver, CO (United States); 26-30 Oct 1991. In *Proceedings of the second Atmospheric Radiation Measurement (ARM) Science Team Meeting.* 169p. Order Number DE93005886. Source: OSTI; NTIS; INIS.

The research conducted as part of these projects breaks down into three broad areas: Radiative transfer involving study of the radiative transfer in 2/3 dimensions as well as the issue of stochastic transfer. Radiative transfer parameterization for use in general circulation models (GCMs) and other climate models. Remote sensing focusing on using our radiative transfer knowledge to address key issues concerning the remote sensing of clouds. In this regard, we focus on new ways of remotely sensing cirrus ice water content. A list of publications in various stages of progress is provided at the end of this paper.

27286 (CONF-9110336–, pp. 39-40) **The effects of cloud heterogeneity on radiant fluxes at the top and bottom of the atmosphere.** Lovejoy, S. (McGill Univ., Montreal, Quebec (CA)); Davis, A.; Tessier, Y.; Schertzer, D.; Borde, R.; Frouin, R.; Gautier, C.; Lavallee, D. USDOE Office of Energy Research, Washington, DC (United States). Environmental Sciences Div. Dec 1992. From 2. Atmospheric Radiation Measurement (ARM) science team meeting; Denver, CO (United States); 26-30 Oct 1991. In *Proceedings of the second Atmospheric Radiation Measurement (ARM) Science Team Meeting.* 169p. Order Number DE93005886. Source: OSTI; NTIS; INIS.

The radiative transfer community is increasingly understanding the crucial role of horizontal cloud heterogeneity in determining the albedos and transmittance properties of clouds. At the same time, the potentially large implications for general circulation model (GCM) parameterizations have not been widely recognized. This project involves a collaboration by four different institutions (UCSB, Scripps, McGill, Meteorologic Nationale), and aims at understanding, modelling, and theoretically and empirically quantifying the heterogeneity. Relating the heterogeneity of the clouds to that of the radiation fields necessarily involves models of cloud intermittency. In the last ten years, great strides in turbulence, chaos, and fractals have enormously broadened the scope of scaling (scale invariant) notions, making such models natural candidates for radiative transfer studies.

27287 (CONF-9110336–, pp. 41-42) **Radiative effects of non-uniform clouds.** Daum, P. (Brookhaven National Lab., Upton, NY (US)); Kleinman, L.; Stephens, G. USDOE Office of Energy Research, Washington, DC (United States). Environmental Sciences Div. Dec 1992. From 2. Atmospheric Radiation Measurement (ARM) science team meeting; Denver, CO (United States); 26-30 Oct 1991. In *Proceedings of the second Atmospheric Radiation Measurement (ARM) Science Team Meeting.* 169p. Order Number DE93005886. Source: OSTI; NTIS; INIS.

The overall objective of the Atmospheric Radiation Measurement (ARM) Science Project 'Radiative Effects of Non-Uniform Clouds" is to improve the treatment of cloud radiation interactions and feedbacks in general circulation models (GCMs) by obtaining a better understanding of the distribution of water in the atmosphere and its relation to the radiation reflected and emitted by clouds. Subobjectives are to test current model parameterizations of short and long wave cloud radiation interactions and to determine the climatological relations between domain average radiative properties and cloud structure. This abstract summarizes an experimental strategy to achieve these objectives, focusing on the measurements likely to be available from the first Cloud and Radiation Testbed (CART) site. An organizing concept that is useful in classifying the individual experiments is a distinction between experiments that are primarily mechanistic or primarily climatological. The emphasis in a mechanistic experiment is to identify morphologically simple cloud systems and assembles of sufficient observations to mechanistically link cloud and radiative properties. This category of experiments is primarily directed at the testing of cloud-radiation parameterizations. In the climatological category of experiments, the emphasis is on accumulating a long-term record

of radiometric, cloud, and meteorological variables, and thereby determining relations between cloud and radiation climatology.

27288 (CONF-9110336–, pp. 43-45) **Interactions between deep convection and upper tropospheric cloudiness.** Randall, D.A. (Colorado State Univ., Fort Collins (US)); Xu, K. USDOE Office of Energy Research, Washington, DC (United States). Environmental Sciences Div. Dec 1992. From 2. Atmospheric Radiation Measurement (ARM) science team meeting; Denver, CO (United States); 26-30 Oct 1991. In *Proceedings of the second Atmospheric Radiation Measurement (ARM) Science Team Meeting.* 169p. Order Number DE93005886. Source: OSTI; NTIS; INIS.

The role of clouds has been identified as a key uncertainty in studies of global climate change (e.g., Cess et al. 1990). Among the most important clouds for climate are the cirrus, cirrostratus, and 'anvil" clouds found in the upper troposphere. These clouds are often produced by the detrainment outflow from deep cumulus convection. They absorb much of the infrared radiation upwelling from below and re-emit it at much lower temperatures, thus producing a strong net radiative warming in the infrared part of the spectrum. Their tendency to cool the Earth by increasing its albedo is also important, but infrared warming typically dominates. In support of the Atmospheric Radiation Measurement (ARM) program, we are developing an improved parameterization of upper tropospheric cloudiness, with emphasis on cloud formation, maintenance, and destruction (as opposed to cloud optical effects) by; following, in parallel, a physically based approach based on the use of prognostic liquid/ice and variables, and an approach similar to that outlined by Randall (1989), together with an improved parameterization of moist convection; conducting preliminary tests of the new parameterizations in a one-dimensional version of the Colorado State University (CSU) general circulation model (GCM), including tests in which the one-dimensional model is "forced' with observations collected at ARM sites; using the UCLA cumulus ensemble model (CEM) to perform further tests of the parameterization, in part by simulating observations collected during ARM, and to suggest model-development strategies; performing climate simulations with the full three-dimensional version of the CSU GCM; and making the improved parameterizations available and adaptable for use in other models, through use of suitable design strategies and also through ARM's Cloud and Radiation Testbed (CART).

27289 (CONF-9110336–, pp. 47-49) **Parameterization tests for the Atmospheric Radiation Measurement Program.** Iacobellis, S.F. (Univ. of California, San Diego (US)); Somerville, R.C.J. USDOE Office of Energy Research, Washington, DC (United States). Environmental Sciences Div. Dec 1992. From 2. Atmospheric Radiation Measurement (ARM) science team meeting; Denver, CO (United States); 26-30 Oct 1991. In *Proceedings of the second Atmospheric Radiation Measurement (ARM) Science Team Meeting.* 169p. Order Number DE93005886. Source: OSTI; NTIS; INIS.

Until Atmospheric Radiation Measurement (ARM) data become available, we are using our single-column model as a testbed to improve and validate parameterizations. As an example of this research, we describe a set of numerical experiments undertaken to compare the results of two cumulus convection parameterizations. The two parameterizations are the Kuo-Anthes scheme (Kuo 1974; Anthes 1977) and the Arakawa and Schubert scheme with and without downdrafts included (Arakawa and Schubert 1974; Kao and Ogura 1987; Ogura and Kao 1987). The model is a one-dimensional diagnostic model (Iacobellis and Somerville 1991a, 1991b) resembling a single column of a general circulation model. The model includes vertical atmospheric transports by convection and turbulent mixing, radiative transfer including interactive clouds, and a surface energy balance coupled to an ocean mixed-layer model. At each time step, observational analyses are used to supply the model with the horizontal advection of heat and moisture. Output from the model includes time series of sea surface temperature, oceanic mixed-layer depth, atmospheric temperature and humidity profiles, precipitation and surface energy budget components. The initial version of this model, which incorporated the cumulus parameterization of Kuo-Anthes, was used in a diagnostic study of the onset of the Indian summer monsoon (Iacobellis and Somerville 1991a, 1991b). In that study the model was run for four weeks beginning about three weeks before the onset of the monsoon. A comparison of the results against independent observational data indicated that the column model is capable of simulating the evolution of the heat and moisture budgets prior to and during the monsoon onset. For the present study, the Arakawa-Schubert (AS) cumulus parameterization has been incorporated. Thus the model can be run with either the Kuo or the AS parameterization.

27290 (CONF-9110336–, pp. 51-54) **Numerical simulations of an idealized convective system: Comparisons between parameterized and explicitly resolved clouds.** Kao, C.Y.J. (Los Alamos National Lab., NM (US)); Bossert, J.E. USDOE Office of Energy Research, Washington, DC (United States). Environmental Sciences Div. Dec 1992. From 2. Atmospheric Radiation Measurement (ARM) science team meeting; Denver, CO (United States); 26-30 Oct 1991. In *Proceedings of the second Atmospheric Radiation Measurement (ARM) Science Team Meeting.* 169p. Order Number DE93005886. Source: OSTI; NTIS; INIS.

One of the objectives of the US Department of Energy's Atmospheric Radiation Measurement (ARM) program is to improve the parameterization of clouds in general circulation models (GCMs). The approach we take in the current research is to examine the behavior of cumulus parameterization schemes by comparing their performance in mesoscale simulations with the results from explicit cloud simulations. Kao and Ogura (1987) compared the 'semi-prognostic" results by the Arakawa-Schubert (A-S) cumulus parameterization scheme with results produced by a cloud ensemble model (CEM) developed by Tao (1983). This earlier study builds the foundation for the present investigation which includes a major refinement. That is, the performance of the A-S scheme is examined in a fully prognostic fashion, and the results are compared with those derived from a fully time-dependent cloud model (i.e., not a CEM which is normally forced by a prescribed time-independent large-scale lifting process), under identical atmospheric conditions. We believe this approach is superior to the one in Kao and Ogura (1987) associated with the semi-prognostic simulations that cannot simulate the feedback processes between the cloud and large-scale fields. We shall call the simulation with the A-S scheme the parameterization case and the one by a detailed cloud model the microphysics case. Note that the only difference between the two cases is that cloud effects are parameterized in the former with a coarser resolution; whereas, each cloud is explicitly resolved by the latter with a much finer resolution. The capability of the A-S scheme in reproducing the growth and life cycle of a cloud system can then be evaluated. The numerical model we have recently acquired from Colorado State University, Regional Atmospheric Modeling System (CSU-RAMS) (Cotton et al. 1988), is used in this research.

27291 (CONF-9110336–, pp. 55-62) **Development of a regional-scale climate model with a detailed microphysics parameterization.** Bossert, J.E. (Los Alamos National Lab., NM (US)); Kao, C.Y.J.; Winterkamp, J.L.; Roads, J.O.; Chen, S.C. USDOE Office of Energy Research, Washington, DC (United States). Environmental Sciences Div. Dec 1992. From 2. Atmospheric Radiation Measurement (ARM) science team meeting; Denver, CO (United States); 26-30 Oct 1991. In *Proceedings of the second Atmospheric Radiation Measurement (ARM) Science Team Meeting.* 169p. Order Number DE93005886. Source: OSTI; NTIS; INIS.

Over the past two decades the meteorological community has witnessed the evolution of general circulation models (GCMs) from studies attempting to simulate realistic large-scale dynamical regimes and energy transports, to present investigations examining future climate change scenarios. This evolution is certain to continue over the next decade, since the GCM community, through the US Department of Energy's Atmospheric Radiation Measurement (ARM) and Computer Hardware, Advanced Mathematics and Model Physics (CHAMMP) programs, has been challenged with producing realistic scenarios for future climate change down to regional-scales (~50 km). Unfortunately, the development of high-resolution GCMs is at least 5 to 10 years away, while the need for information on potential climate change impacts over specific regions is immediate. The regional climate issue can be dealt with in several ways. One approach has been to use existing coarse-scale GCM

out put to focus in on particular regions (Gutowski et al. 1991; Grotch and MacCracken 1991). However, the mismatch in scale between the GCM and the processes driving the regional climate limit the representativeness of these studies. A more realistic alternative is to implement a model with a finer resolution mesh over the region of interest within a GCM. For example, a limited area (i.e., mesoscale) model could be initialized with, and forced on the boundaries by, GCM output or other large-scale data sets, over an extended period. Studies have shown that mesoscale models can provide a regional climatology that is of sufficient detail to be useful for global change assessments, provided that the model's performance can be adequately validated with existing data.

27292 (CONF-9110336–, pp. 63-66) **CHAMMP program overview.** MacCracken, M.C. (Lawrence Livermore National Lab., CA (US)). USDOE Office of Energy Research, Washington, DC (United States). Environmental Sciences Div. Dec 1992. From 2. Atmospheric Radiation Measurement (ARM) science team meeting; Denver, CO (United States); 26-30 Oct 1991. In *Proceedings of the second Atmospheric Radiation Measurement (ARM) Science Team Meeting.* 169p. Order Number DE93005886. Source: OSTI; NTIS; INIS.

The Computer Hardware, Advanced Mathematics, and Model Physics (CHAMMP) program is a relatively new component of the Global Change Research Program sponsored by the Environmental Sciences Division (ESD) of the US Department of Energy (DOE). Dr. David Bader leads the program, assisted by Dr. Robert Malone and myself. CHAMMP is an integral part of the ESD climate modeling program and its objectives are highly complementary to the modeling activities being conducted as part of DOE's Program for Climate Model Diagnosis and Inter comparison. CHAMMP is also closely linked to the US Global Change Research Program, especially through its interactions with the major climate modeling centers of the other agencies. Because of its need for and focus on use of forefront supercomputers,CHAMMP is also a contributing program in the High Performance Computing and Communications Program, which is a new Presidential Initiative dedicated to the 'grand challenge' computational problems. Just as the Atmospheric Radiation Measurement (ARM) program was formed in recognition of the inability of current general circulation models (GCMS) to satisfactory represent cloud formation, convection, and radiative processes, the CHAMMP program was organized in response to the need to harness greater computational power in the pursuit of regionally resolved projections of climate change. For a number of reasons, current GCMs simply are not adequate for making accurate projections of future climate. The types of problems for which models must be developed and tested include coupled ocean-atmosphere simulations with 50- to 100-km resolution and extending centuries in duration, simulations that represent the evolution of atmospheric composition from 1750 out to 2100, simulations of the evolution of global ecosystems and biogeochemical cycles, and studies of paleoclimatic changes.

27293 (CONF-9110336–, pp. 67-68) **Data assimilation and the Atmospheric Radiation Measurement Program.** Louis, J.F. (Atmospheric and Environment Research, Inc., Cambridge, MA (US)). USDOE Office of Energy Research, Washington, DC (United States). Environmental Sciences Div. Dec 1992. From 2. Atmospheric Radiation Measurement (ARM) science team meeting; Denver, CO (United States); 26-30 Oct 1991. In *Proceedings of the second Atmospheric Radiation Measurement (ARM) Science Team Meeting.* 169p. Order Number DE93005886. Source: OSTI; NTIS; INIS.

This paper is a brief introduction to data analysis and assimilation concepts; its purpose is to define the role of data assimilation in the Atmospheric Radiation Measurement (ARM) program. It may be useful to start with a very short, and probably oversimplified, historical perspective on the treatment of data in meteorology and, more specifically, in weather prediction. The original concept of data analysis was a way of establishing a picture of a meteorological field on the basis of more or less randomly distributed observations. Long before the advent of computers, meteorologists were routinely contouring fields by hand, using synoptic observations. To a large extent, this was an art as much as a science, but it allowed the development of techniques, some mathematical and some purely graphical, to predict the evolution of the fields. From very early on, it was recognized that data should not necessarily be taken at face value and that drawing to the data was not necessarily the best way to go. Already in the days of hand analyses, conceptual models were used. With the development of computers, a lot of effort was devoted to trying to automate the process of hand analysis of meteorological data. Curve fitting and statistical interpolation were the two main directions followed. At the same time as the concept of data assimilation was developed (in the sixties), new sources of data, mainly from satellites, were becoming available. The concept of optimal interpolation was then developed. It is only a short step from optimal interpolation to the principle of variational assimilation which is currently under development. In the context of ARM, it is clear that the role of data assimilation will be mainly to provide a continuous, internally consistent picture of the atmospheric state over the Cloud and Radiation Testbed (CART) site, in order to provide appropriate initial conditions and verification data for models and parameterization experiments.

27294 (CONF-9110336–, pp. 69-72) **Testbed model and single column data assimilation for the Atmospheric Radiation Measurement Program.** Louis, J.F. (Atmospheric and Environment Research, Inc., Cambridge, MA (US)). USDOE Office of Energy Research, Washington, DC (United States). Environmental Sciences Div. Dec 1992. From 2. Atmospheric Radiation Measurement (ARM) science team meeting; Denver, CO (United States); 26-30 Oct 1991. In *Proceedings of the second Atmospheric Radiation Measurement (ARM) Science Team Meeting.* 169p. Order Number DE93005886. Source: OSTI; NTIS; INIS.

Atmospheric and Environment Research's (AER) project for the Atmospheric Radiation Measurement (ARM) project is to further develop and test a model originally designed for local weather prediction. This model will be used for three distinct but related purposes: (1) to provide a single column model testbed that simulates a global climate model, in order to facilitate the development and testing of new cloud parameterizations and radiation models; (2) to assimilate the ARM data continuously at the scale of a climate model, using the adjoint method, thus providing the initial conditions and verification data for testing parameterizations in single column model studies; (3) to study the sensitivity of a radiation scheme to cloud parameters, again using the adjoint method, thus demonstrating the usefulness of the testbed model. In the first couple of years of the contract we will concentrate on developing the data assimilation system. Two of the big problems with using the ARM data will be its scale representativity (or lack thereof) and its incompleteness. Data assimilation is one way to address both problems. Data assimilation can be described as a way to generate a complete and continuous picture of the atmospheric profile above the Cloud and Radiation Testbed (CART) site. A model is used to define the characteristic scale of the solution, to provide time continuity, and to ensure dynamical balance of the fields. The model also provides an estimate of atmospheric quantities that are not directly measured. To the extent that the model is a reasonable representation of the atmosphere, these computed quantities are, at least, consistent with the observations.

27295 (CONF-9110336–, pp. 73-76) **An integrated cloud observation and modeling investigation in support of the Atmospheric Radiation Measurement Program.** Ackerman, T. (Pennsylvania State Univ., University Park (US)); Albrecht, B.; Lamb, D.; Seaman, N.; Thomson, D.; Warner, T. USDOE Office of Energy Research, Washington, DC (United States). Environmental Sciences Div. Dec 1992. From 2. Atmospheric Radiation Measurement (ARM) science team meeting; Denver, CO (United States); 26-30 Oct 1991. In *Proceedings of the second Atmospheric Radiation Measurement (ARM) Science Team Meeting.* 169p. Order Number DE93005886. Source: OSTI; NTIS; INIS.

Although the cloud observation and modeling investigation is an integrated project, it subdivides into three components. The first centers on the operations of the Cloud Observing System (COS). This includes instrument development, data acquisition, data analysis, and algorithm development. A large part of our activities in this first year have focused on this particular component. The second focuses on physically-based process models designed to simulate cloud and radiation interactions. During the first year, the activity in

this area has been largely developmental. The third component centers on the mesoscale modeling. The focus of this work is on model development and testing, particularly in the area of cloud properties. Again, this work has been largely developmental in the first year. The natural flow of the project is from the observational database to the process model simulations to the incorporation of cloud parameterizations into the mesoscale model. Our intent is to use the process models, in conjunction with the observations, to expand our understanding of cloud formation and maintenance and interactions with the radiation budget. The model studies, observations, and new insights will form the basis on which improved and new parameterizations will be developed and incorporated into the mesoscale model.

27296 (CONF-9110336–, pp. 77-80) **An integrated data assimilation and sounding system.** Dabberdt, W.F. (National Center for Atmospheric Research, Boulder, CO (US)); Martin, C.; Cole, H.L.; Dudhia, J.; Horst, T.; Kuo, Y.H.; Oncley, S.; Baelen, J. van; Gage, K.S.; Ecklund, W.; Carter, D.; Strauch, R.; Westwater, E.R.; Revercomb, H.; Smith, W.L.USDOE Office of Energy Research, Washington, DC (United States). Environmental Sciences Div. Dec 1992. From 2. Atmospheric Radiation Measurement (ARM) science team meeting; Denver, CO (United States); 26-30 Oct 1991. In *Proceedings of the second Atmospheric Radiation Measurement (ARM) Science Team Meeting.* 169p. Order Number DE93005886. Source: OSTI; NTIS; INIS.

The Integrated Data Assimilation and Sounding System (IDASS) provides high-resolution tropospheric structure through the use of atmospheric measurements and a dynamic mesoscale model. The measurement system (Integrated Sounding System, or ISS) is developed around a suite of in situ and active and passive remote sensors which individually satisfy certain needs, but which together function in a complementary mode. ISS subsystems may include: multiple-frequency UHF wind profiler(s) with a_ radio acoustic sounding system (RASS); a Navaid-based sounding system; a surface meteorological station; a microwave profiler (MWR); a high-resolution infrared sounder; and a laser ceilometer. The ISS operates as an integrated system. Important aspects of the system are the synergistic interaction of data streams from the individual instruments and the application of real-time and post facto data assimilation, as well as the mechanical integration that provides a central data acquisition, processing, display and communications capability in the field for re- search studies. Measurements from the in situ and remote sensing instruments are coupled with a state-of-the-art mesoscale modeling system. In the mesoscale data assimilation process, the model solution is relaxed toward the available observations so that it is consistent with the measurements. Over regions where there are no observations, the evolution of the model fields is constrained by model dynamics and physics. The end product is a highly resolved four-dimensional meteorological dataset (including three components of wind, temperature, humidity, cloud water, and integrated moisture). The mesoscale data assimilation scheme is the Newtonian nudging technique. During the data assimilation period, observations of wind, temperature, and humidity are used to nudge (or relax) the time dependent model variables to the observed values.

27297 (CONF-9110336–, pp. 81-82) **A field evaluation of NOAA remote sensor measurements of wind, temperature, and moisture.** Martner, B.E. (National Oceanic and Atmospheric Administration, Boulder, CO (US)). USDOE Office of Energy Research, Washington, DC (United States). Environmental Sciences Div. Dec 1992. From 2. Atmospheric Radiation Measurement (ARM) science team meeting; Denver, CO (United States); 26-30 Oct 1991. In *Proceedings of the second Atmospheric Radiation Measurement (ARM) Science Team Meeting.* 169p. Order Number DE93005886. Source: OSTI; NTIS; INIS.

The Atmospheric Radiation Measurement (ARM) program goals are ambitious, and its schedule is demanding. Many of the instruments, proposed for operations at the first Cloud and Radiation Testbed (CART) site as early as 1992 represent emerging technology and exist only as special research prototypes. Therefore, an important preparatory step for ARM was an intensive field project in Colorado in 1991 to assess the suitability of instruments and techniques for profiling the thermodynamic and kinematic structure of the troposphere and lower stratosphere. The field work was designed to provide ARM with a head start by gathering practical information for the design and operation of the CART sites. Additional longer term research, also fundamental to ARM goals, will use the 1991 data to design an optimized combination of diverse profiling instruments. The data will also be used to extrapolate single site data to dynamically consistent, four-dimensional fields at general circulation model (GCM) subgrid scales using a data assimilation mesoscale model. The result will be an integrated system for atmospheric profiling tailored to ARM's needs. This ARM Science Team research is being conducted by a partnership that includes the National Center for Atmospheric Research (NCAR), the National Oceanic and Atmospheric Administration (NOAA) the Wave Propagation Laboratory (WPL), the Aeronomy Laboratory, and the University of Wisconsin. NOAA has also conducted shorter range infrastructure research for ARM/CART in which the performance of the NOAA remote sensors used in the 1991 field project was examined. Recommendations for CART instrumentation were derived from these evaluations and from the experience that NOAA scientists and engineers have obtained by designing and operating these instruments over the years. This research is reported in a NOAA Technical Memorandum by Manner et al. (1991).

27298 (CONF-9110336–, pp. 83-85) **The boardman ARM regional flux experiment.** Doran, J.C. (Pacific Northwest Lab., Richland, WA (US)). USDOE Office of Energy Research, Washington, DC (United States). Environmental Sciences Div. Dec 1992. From 2. Atmospheric Radiation Measurement (ARM) science team meeting; Denver, CO (United States); 26-30 Oct 1991. In *Proceedings of the second Atmospheric Radiation Measurement (ARM) Science Team Meeting.* 169p. Order Number DE93005886. Source: OSTI; NTIS; INIS.

In June 1991, a field campaign was conducted to study the effects of sub-grid scale variability of surface sensible and latent heat fluxes on surface boundary layer properties and to provide data with which to address the problem of extrapolating from a limited number of local measurements to obtain areal-averaged values of fluxes appropriate for use in general circulation models (GCMs). Participants in the campaign included DOE's Argonne National Laboratory, Los Alamos National Laboratory, Pacific Northwest Laboratory, the National Oceanic and Atmospheric Administration's Atmospheric Turbulence and Diffusion Division, and several other collaborators. We sought an experimental site in which surface fluxes of sensible and latent heat could be expected to differ sharply from one surface to another (with each surface of order 10 km in length) but would show relatively minor variations over any particular surface. With such a site, we hoped to see a clear signature of the effects of surface inhomogeneities, test one or more parametric schemes relating turbulent fluxes to vertical gradients of mean quantities, evaluate methods of measuring surface fluxes over inhomogeneous terrain, examine the variation of surface fluxes over a range of scales, and establish procedures for extrapolating flux values from smaller scales to larger ones.

27299 (CONF-9110336–, pp. 87-92) **Measurements of surface heat flux over contrasting surfaces.** Coulter, R.L. (Argonne National Lab., IL (US)); Shannon, J.D.; Martin, T.J. USDOE Office of Energy Research, Washington, DC (United States). Environmental Sciences Div. Dec 1992. From 2. Atmospheric Radiation Measurement (ARM) science team meeting; Denver, CO (United States); 26-30 Oct 1991. In *Proceedings of the second Atmospheric Radiation Measurement (ARM) Science Team Meeting.* 169p. Order Number DE93005886. Source: OSTI; NTIS; INIS.

In a multilaboratory field study held near Boardman in northeastern Oregon in June 1991 and described in greater detail elsewhere (Doran et al. 1991), various properties of the surface and lower atmospheric boundary layer over heavily irrigated cropland and adjacent desert steppe were investigated. The locale was selected because its disparate characteristics over various spatial scales stress the ability of general circulation models (GCMS) to describe lower boundary conditions, particularly across the discontinuity between desert (in which turbulent flux of heat must be primarily as sensible heat) and large irrigated tracts (in which turbulent flux of latent heat should be the larger term).

27300 (CONF-9110336–, pp. 93-97) **Remote sensing of surface fluxes important to cloud development.** Barnes, F.J. (Los Alamos National Lab., NM (US)); Porch, W.; Cooper, D.; Kunkel, K.E.; Hipps, L. USDOE Office of Energy Research, Washington, DC (United States). Environmental Sciences Div. Dec 1992. From 2. Atmospheric Radiation Measurement (ARM) science team meeting; Denver, CO (United States); 26-30 Oct 1991. In *Proceedings of the second Atmospheric Radiation Measurement (ARM) Science Team Meeting.* 169p. Order Number DE93005886. Source: OSTI; NTIS; INIS.

The lower boundary of the GCM (general circulation model) modeling domain, the earth's surface, exerts a strong influence on regional dynamics of heat and water vapor, and the heterogeneity in the surface features can be responsible for generating regional mesoscale circulation patterns. Changes in the surface vegetation due to anthropogenic activity can cause substantial changes in the ratio of sensible to latent heat flux and result in climate changes that may be irreversible. A broad variety of models for representing energy fluxes are in use, from individual leaf and canopy models to mesoscale atmospheric models and GCMS. Scaling-up a model is likely to result in significant errors, since biophysical responses often have nonlinear dependence on the abiotic environment. Thus, accurate and defensible methods for selecting measurement scales and modeling strategies are needed in the effort to improve GCMS. There are few data sets that detail the fluxes, soil and vegetative characteristics, and topographic and landscape features over broad spatial and regional scales. Yet if we are to arrive at a functional average of the soil and vegetation properties over a GCM grid cell, such datasets of interrelating variables must be obtained in order to determine the appropriate scale for the measurements of these features at other sites and to estimate inherent variability and uncertainty in measurements made at different scales. Finally, to avoid the errors that are inherent in transferring across scales, a formulation of processes across a grid cell requires simplifications in modeling at larger scales that must be validated from detailed 'bottom-up" mechanistic studies and bounded by sensitivity tests. To address some of these issues in scaling and averaging of measurements, a collaborative field campaign was conducted in June 1991 by the DOE laboratories funded under the ARM program.

27301 (CONF-9110336–, pp. 99-102) **Parameterization of convective clouds, mesoscale convective systems, and convective-generated clouds.** Cotton, W.R. (Colorado State Univ., Fort Collins (US)). USDOE Office of Energy Research, Washington, DC (United States). Environmental Sciences Div. Dec 1992. From 2. Atmospheric Radiation Measurement (ARM) science team meeting; Denver, CO (United States); 26-30 Oct 1991. In *Proceedings of the second Atmospheric Radiation Measurement (ARM) Science Team Meeting.* 169p. Order Number DE93005886. Source: OSTI; NTIS; INIS.

This presentation is a summary of research progress supported under the Atmospheric Radiation Measurement (ARM) project entitled 'Parameterization of Convective Clouds, Mesoscale Convective Systems, and Convective-Generated Clouds.' The approach used in this research is to perform explicit simulations of convective clouds and mesoscale convective systems for well-documented observed cases. The simulated data are used to help us in fabricating, calibrating, and testing parameterization schemes of these cloud systems. The approach is analogous to the large-eddy-simulation (LES) approach that has been quite successfully used in developing parameterizations of turbulent transport in the convective boundary layer. The work builds on research by Weissbluth (1991) who developed parameterizations of deep convective clouds updrafts and downdrafts.

27302 (CONF-9110336–, pp. 103-109) **Multi-spectral automated rotating shadowband radiometry.** Harrison, L. (State Univ. of New York, Albany (US)). USDOE Office of Energy Research, Washington, DC (United States). Environmental Sciences Div. Dec 1992. From 2. Atmospheric Radiation Measurement (ARM) science team meeting; Denver, CO (United States); 26-30 Oct 1991. In *Proceedings of the second Atmospheric Radiation Measurement (ARM) Science Team Meeting.* 169p. Order Number DE93005886. Source: OSTI; NTIS; INIS.

Two related instruments are being developed for use in the Atmospheric Radiation Measurement (ARM) program; both use an automated rotating shadow band technique to make spectrally resolved measurements of the direct-normal, total horizontal, and diffuse horizontal irradiances. These parameters of the sky-radiance function are measured using the same detector (for a given wavelength), eliminating the difficulties inherent in comparing these data when measured by independent detectors. The first of these instruments uses independent interference-filter/photodiode detectors to measure any seven wavelength bands chosen between 350 nm and 2.5 μm. Nine of these multiple filter instruments are currently deployed as part of the US Department of Energy's (DOE) Quantitative Links measurement program. This instrument has been selected for deployment in the spring of 1992 at the extended field sites of the first Cloud and Radiation Testbed (CART) installation. The second instrument uses a prism spectrograph and a Charge-Coupled Device (CCD) photodiode array to measure 256 wavelength intervals from 370 nm to 1 μm. This instrument, which is at the prototype stage, is intended for deployment at the central sites. In this abstract, the technical features of these two instruments and data recovery and interpretation for sky conditions in which single-scattering dominates are described.

27303 (CONF-9110336–, pp. 111-114) **New shortwave solar radiometer with information-based sparse sampling.** Simpson, M.L. (Oak Ridge National Lab., TN (US)); Carnal, C.L.; Ericson, M.N.; Falter, D.D.; Falter, K.G.; Jellison, G.E. Jr.; Kryter, R.C.; Maddox, S.R.; Munro, J.K.; Rochelle, J.M.; Spratlin, T.L. USDOE Office of Energy Research, Washington, DC (United States). Environmental Sciences Div. Dec 1992. DOE Contract AC05-84OR21400. From 2. Atmospheric Radiation Measurement (ARM) science team meeting; Denver, CO (United States); 26-30 Oct 1991. In *Proceedings of the second Atmospheric Radiation Measurement (ARM) Science Team Meeting.* 169p. Order Number DE93005886. Source: OSTI; NTIS; INIS.

A new concept for a real-time shortwave solar radiometer is presented, based on the premise that high resolution measurements of the shortwave solar spectrum are needed only in wavelength regions where the atmospheric physics are changing rapidly with respect to 1. The design features holographic optical elements (HOES) for nonuniform sampling of the spectrum, customized photocells, and temperature-compensated monolithic wide dynamic range amplifiers. Preliminary results show full spectrum reconstruction accuracies to $< 3\%$ with a 10:1 reduction in the number of photocells required.

27304 (CONF-9110336–, pp. 115-119) **The Radiation Measurement System (RAMS).** Valero, F.P.J. (NASA, Ames Research Center, Moffett Field, CA (US)); Pilewskie, P. USDOE Office of Energy Research, Washington, DC (United States). Environmental Sciences Div. Dec 1992. From 2. Atmospheric Radiation Measurement (ARM) science team meeting; Denver, CO (United States); 26-30 Oct 1991. In *Proceedings of the second Atmospheric Radiation Measurement (ARM) Science Team Meeting.* 169p. Order Number DE93005886. Source: OSTI; NTIS; INIS.

Radiative processes in the atmosphere are at the heart of anthropogenically induced climatic changes. High quality measurements of radiative parameters must be obtained to be able to characterize the way in which the interaction of radiation with the atmosphere results in climatic change and evolution. With the goal of contributing to the above objective we are developing state-of-the-art radiation measuring instruments. We are using the latest technology and extensive heritage from our aircraft and spacecraft systems to achieve the stringent requirements of the Atmospheric Radiation Measurement (ARM) program. The Radiation Measurement System (RAMS) will provide infrared spectral and broadband fluxes and radiances. Furthermore, the RAMS will be an integrated system with central instruments control, real time data processing and display, and the modeling capacity to monitor the progress of the experiments. We also plan to offer, for consideration by the science team, prototype field demonstrations of novel solar multichannel instrumentation (the solar instrumentation is being minimally funded by other sources). The combination of self consistent, infrared (IR) and shortwave radiometers is, in our opinion, crucial to meet the ARM requirements.

27305 (CONF-9110336–, pp. 121-124) **High spectral resolution fourier transform infrared (FTIR) instruments for the Atmospheric Radiation Measurement Program: Focus on the atmospheric emitted radiance interferometer.** Revercomb, H.E. (Univ. of Wisconsin, Madison (US)); Best, F.A.; Dedecker, R.G.; Dirkx, T.P.; Herbsleb, R.A.; Knuteson, R.O.; Short, J.F.; Smith, W.L. USDOE Office of Energy Research, Washington, DC (United States). Environmental Sciences Div. Dec 1992. From 2. Atmospheric Radiation Measurement (ARM) science team meeting; Denver, CO (United States); 26-30 Oct 1991. In *Proceedings of the second Atmospheric Radiation Measurement (ARM) Science Team Meeting.* 169p. Order Number DE93005886. Source: OSTI; NTIS; INIS.

Ground-based Fourier Transform infrared (FTIR) instruments are being produced at the University of Wisconsin (UW) and the University of Denver (UD) for the Atmospheric Radiation Measurement (ARM) Program's Cloud and Radiation Testbed (CART) sites as part of a joint Instrument Development Program (IDP). The three instrument types underdevelopment are summarized. For each ARM site, the 1 cm^{-1} resolution Atmospheric Emitted Radiance Interferometer (AERI) is expected to be operated both at the central site and at four extended boundary locations to allow its use for radiometric studies and for remote sensing of horizontal inhomogeneities. The AERI is being built by the UW and is the primary subject of this report. The extra high resolution AERI-X and the ultra high resolution Solar Radiance Transmission Interferometer (SORTI) are planned for the central sites and are described in more detail in a separate abstract by the UD.

27306 (CONF-9110336–, pp. 125-126) **Tethered balloon sounding system for vertical radiation profiles.** Whiteman, C.D. (Pacific Northwest Lab., Richland, WA (US)); Alzheimer, J.M.; Anderson, G.A.; Garnich, M.R.; Shaw, W.J. USDOE Office of Energy Research, Washington, DC (United States). Environmental Sciences Div. Dec 1992. From 2. Atmospheric Radiation Measurement (ARM) science team meeting; Denver, CO (United States); 26-30 Oct 1991. In *Proceedings of the second Atmospheric Radiation Measurement (ARM) Science Team Meeting.* 169p. Order Number DE93005886. Source: OSTI; NTIS; INIS.

A small, tethered balloon sounding system is being developed to make broadband radiometric and meteorological profiles through the lowest 1500 m of the atmosphere. The major technical issue of this instrument development project is the construction of a stable platform that will keep the complement of radiometric instruments level, regardless of balloon motion. A prototype stable platform, called the Sky Platform, has now been completed and is being demonstrated in the poster session of the science team meeting. The Sky Platform is an equilateral triangle approximately 65 cm on a side and formed from aluminum tubing. A mount for radiometric and horizontal sensors is supported inside the triangle, and the Sky Platform is carried on the tetherline 30 m or more below a small, helium-filled, tethered balloon. At a point 30 m below the balloon, the main tetherline branches into a 3-m-long section of three lines, only to rejoin the main tetherline at the end of the 3-m section. The Sky Platform is carried within the 3-m-long section. One corner of the Sky Platform is attached to one of the lines at the center of the 3-m-long section, while the remaining corners of the Sky Platform are attached to the remaining two lines through pulleys driven by small electric motors. The platform is kept level by an automatic control loop which interrogates the horizontal sensors (accelerometers) on the Sky Platform and drives the motors and pulleys to keep the Sky Platform level. A flux gate magnetometer provides platform heading information.

27307 (CONF-9110336–, pp. 127-129) **Cloud and aerosol characterization for the ARM central facility: Multiple remote sensor techniques development.** Sassen, K. (Univ. of Utah, Salt Lake City (US)). USDOE Office of Energy Research, Washington, DC (United States). Environmental Sciences Div. Dec 1992. From 2. Atmospheric Radiation Measurement (ARM) science team meeting; Denver, CO (United States); 26-30 Oct 1991. In *Proceedings of the second Atmospheric Radiation Measurement (ARM) Science Team Meeting.* 169p. Order Number DE93005886. Source: OSTI; NTIS; INIS.

Our research program to establish how active and passive remote sensing information can best be applied to the problem of characterizing the cloudy atmosphere has two basic components. The first task, which we have nearly completed, is the fabrication of a state-of-the-art dual-wavelength Polarization Diversity Lidar (PDL) system to thoroughly evaluate the various lidar polarization techniques for cloud and aerosol research. As recently reviewed in Sassen (1991), the basic two-channel method for measuring linear depolarization has been highly effective as a cloud microphysical research tool. Through the use of linear depolarization ratios, water and ice particle clouds can be unambiguously discriminated, and a number of ice particle types and orientations can be identified. (These capabilities should improve as geometrical optics ray-tracing theory is applied to predicting ice crystal habit depolarization ratios.) Nonetheless, there is still much to be explored in the polarization lidar field, including the information contents of additional backscatter polarization (i.e., four-channel Stokes) parameters, simultaneous multiple-wavelength and multiple-polarization state (including circular) laser probing, and the variable receiver field-of-view (FOV) technique for studying multiple scattering depolarization and particle size inversion.

27308 (CONF-9110336–, pp. 131-134) **Laser remote sensing of water: Raman lidar development.** Goldsmith, J.E.M. (Sandia National Labs., Livermore, CA (US)); Lapp, M.; Bisson, S.E.; Melfi, S.H.; Whiteman, D.N.; Ferrare, R.A. USDOE Office of Energy Research, Washington, DC (United States). Environmental Sciences Div. Dec 1992. From 2. Atmospheric Radiation Measurement (ARM) science team meeting; Denver, CO (United States); 26-30 Oct 1991. In *Proceedings of the second Atmospheric Radiation Measurement (ARM) Science Team Meeting.* 169p. Order Number DE93005886. Source: OSTI; NTIS; INIS.

We outline here our research program to develop an optimized critical design for a Raman lidar system for measuring daytime profiles of atmospheric water vapor. The Raman lidar technique is a leading candidate for providing the high-resolution, day-night profiling of water vapor that is critical to programs in global climate change research. Because of the crucial role that water vapor plays directly in the earth's radiation budget as an absorber, as well as its role in cloud formation and optical phenomenology, accurate, three-dimensional measurements of water-vapor concentration are an essential part of the experimental capability that we anticipate will be required for climate-change research. Raman lidar is currently used to perform meteorologically important, sustained, reliable nighttime profiling of water vapor; typical configurations yield random uncertainties of less than $\pm 10\%$ out to ranges of 7 km in 2-minute integration periods with range resolution on the order of 100 m (Melfi and Whiteman 1985; Melfi et al. 1989; Whiteman et al., in press). Daytime measurements are much more difficult because of the difficulties inherent in detecting the weak Raman signal against solar backgrounds. Demonstrations to date have been limited to ranges on the order of 1 km (Petri et al. 1982; Renaut et al. 1980; Renaut and Capitini 1988). This paper will describe our development of a solar-blind Raman lidar capable of extended-range daytime profiling of atmospheric water vapor. The first part of the paper will describe the principle of solar-blind operation and discuss the computer model being developed to guide optimization of the instrument configuration. The second part of the paper will focus on an overview of the laboratory research being performed to support the model and instrument development. Finally, we will describe our participation in SPECTRE (Spectral Radiance Experiment), a major field experiment held during the fall of 1991.

27309 (CONF-9110336–, pp. 135-136) **Development of a cloud profiling radar system.** McIntosh, R.E. (Univ. of Massachusetts, Amherst (US)); Pazmany, A.; Sekelsky, S.; Mead, J. USDOE Office of Energy Research, Washington, DC (United States). Environmental Sciences Div. Dec 1992. From 2. Atmospheric Radiation Measurement (ARM) science team meeting; Denver, CO (United States); 26-30 Oct 1991. In *Proceedings of the second Atmospheric Radiation Measurement (ARM) Science Team Meeting.* 169p. Order Number DE93005886. Source: OSTI; NTIS; INIS.

In this presentation we summarize our achievements during the past year in developing a Cloud Profiling Radar System (CPRS). This system will eventually operate simultaneously at both 35 and

95 GHz. It will be coherent (to measure Doppler frequency shifts owing to cloud particle motions) and fully polarimetric. Although much of our activity has been concerned with the engineering of the 35- and 95-GHz radar systems and an integrated antenna system, we also have had the opportunity to conduct preliminary field experiments with the University of Wyoming at Elk Mountain, Wyoming. These experiments were also supported by the National Science Foundation in order to determine the depolarizing characteristics of cloud ice particles.

27310 (CONF-9110336–, pp. 137-140) **Status of instrumentation for the southern Great Plains clouds and radiation testbed.** Wesely, M.L. (Argonne National Lab., IL (US)). USDOE Office of Energy Research, Washington, DC (United States). Environmental Sciences Div. Dec 1992. From 2. Atmospheric Radiation Measurement (ARM) science team meeting; Denver, CO (United States); 26-30 Oct 1991. In *Proceedings of the second Atmospheric Radiation Measurement (ARM) Science Team Meeting.* 169p. Order Number DE93005886. Source: OSTI; NTIS; INIS.

Planning for the initial complement of instrumentation at the first Cloud and Radiation Testbed (CART) site has concentrated on obtaining a sufficient level of instrumentation at the central facility for studies of radiative transfer processes in a narrow column above the site. The auxiliary facilities, whose sole purpose is cloud mapping above the central facility, will not be activated as such until provisions are made for all-sky imaging systems. In the meantime, the auxiliary facilities will be instrumented as extended facilities if the locations are suitable, which would be the case if they serve the primary purpose of the extended facilities, i.e., obtaining representative measurements of surface energy exchanges, state variables, precipitation, soil and vegetative conditions, and other factors that must be considered in terms of boundary conditions by single-column and related models. The National Oceanic and Atmospheric Administration (NOAA) radar wind profiler network is being considered to provide observations of vertical profiles at the boundaries of the CART site. If possible, these locations will be used for boundary facilities. Efforts are proceeding to gain access to the wind profiler network data and to determine if a sufficient number of the profilers can be equipped as Radio Acoustic Sounding Systems (RASS). Profiles of temperature as well as winds are needed at the boundary facilities for studies with single-column models and four-dimensional data assimilation models. Balloon-borne sounding systems will be used there initially for both temperature and moisture profiles. Infrared spectrometers will eventually be used to infer moisture profiles at these boundary facilities.

27311 (CONF-9110336–, pp. 141-143) **Vision statement for research and educational outreach for the ARM CART southern Great Plains locale.** Lamb, P.J.; Crawford, K.C.; Brock, F.V.; Rabin, R.M. USDOE Office of Energy Research, Washington, DC (United States). Environmental Sciences Div. Dec 1992. From 2. Atmospheric Radiation Measurement (ARM) science team meeting; Denver, CO (United States); 26-30 Oct 1991. In *Proceedings of the second Atmospheric Radiation Measurement (ARM) Science Team Meeting.* 169p. Order Number DE93005886. Source: OSTI; NTIS; INIS.

Our proposal capitalized on and reflected the considerable collective expertise in the atmospheric sciences (both research and educational) that resides in the 'Weather Center" assemblage of organizations on the University of Oklahoma (OU) campus. This 'Weather Center' has the following components: OU School of Meteorology (SOM); OU-NSF Center for Analysis and Prediction of Storms (CAPS); OU-National Oceanic and Atmospheric Administration (NOAA) Cooperative Institute for Mesoscale Meteorological Studies (CIMMS); Oklahoma Climatological Survey (OCS); NOAA/ Environmental Research Laboratories (EARL) National Severe Storms Laboratory (NSSL); Operational Support Facility for the Weather Surveillance Radar - 88 Doppler Program of the National Weather Service (OSF WSR-88D); National Weather Service Forecast Office (NWSFO). All of these 'Weather Center' entities will make vital contributions to the program of research and education outreach proposed for the Southern Great Plains locale for the Atmospheric Radiation Measurement (ARM) program's Cloud and Radiation Testbed (CART). The research component of the program is guided by the overall goal of the ARM program to improve the treatment of cloud radiative forcing and feedbacks in general circulation models (GCMs) and to improve the empirical characterization of the cloud and radiative processes in the Earth's atmosphere and the parameterization of the processes in atmospheric models. The goal of educational outreach will be to use a multi-disciplinary approach that combines meteorology, climatology, computer graphics, telecommunications, geography, geology, and agriculture in a series of applied environmental projects designed to educate a new generation of precollege and college students about our environment, its impact on our society, and the consequences of a changed climate in the 21st century.

27312 (CONF-9110336–, pp. 145-150) **Tropical western Pacific project: Status.** Clements, W. (Los Alamos National Lab., NM (US)); Ackerman, T.; Renne, D. USDOE Office of Energy Research, Washington, DC (United States). Environmental Sciences Div. Dec 1992. From 2. Atmospheric Radiation Measurement (ARM) science team meeting; Denver, CO (United States); 26-30 Oct 1991. In *Proceedings of the second Atmospheric Radiation Measurement (ARM) Science Team Meeting.* 169p. Order Number DE93005886. Source: OSTI; NTIS; INIS.

The Atmospheric Radiation Measurement (ARM) Program's Tropical Western Pacific (TWP) locale will be the location of the second of five primary Cloud and Radiation Testbed (CART) sites. The locale lies in the tropical warm pool region roughly between 100 S to 100 N of the equator and from 1300 E to the dateline. Phased implementation is scheduled to begin in late 1993. The main activity of the TWP project in the next year is to define the particular science to be conducted and to select an appropriate site or sites to make the required measurements. The science questions of interest to ARM fall under 5 general headings: (1) Cloud-radiation interactions, (2) Vertical transports of mass and energy, (3) Air-sea interaction, (4) Initiation of convection, and (5) The coupling of the tropics to the mid-latitude. These headings are broad and collectively span a tremedous diversity of atmospheric and oceanic processes. It is uncertain whether all of these areas can be addressed using data collected at the TWP CART site. Thus, one of the high priorities over the next year will be to define science issues and prioritize the issues with regard to data collection and use of ARM resources.

27313 (CONF-9110336–, pp. 151-153) **The north slope of Alaska: The Atmospheric Radiation Measurement Program's window on high latitude phenomena.** Zak, B.D. (Sandia National Labs., Albuquerque, NM (US)); Stamnes, K. USDOE Office of Energy Research, Washington, DC (United States). Environmental Sciences Div. Dec 1992. From 2. Atmospheric Radiation Measurement (ARM) science team meeting; Denver, CO (United States); 26-30 Oct 1991. In *Proceedings of the second Atmospheric Radiation Measurement (ARM) Science Team Meeting.* 169p. Order Number DE93005886. Source: OSTI; NTIS; INIS.

A major thrust of the Atmospheric Radiation Measurement (ARM) Program is the establishment of five primary and four supplementary Cloud and Radiation Testbed (CART) sites. The CART sites will provide the means to acquire the necessary data to test and further develop the components of general circulation models (GCMs), which describe the relationships between the characteristics of the atmosphere and the solar and thermal radiation which passes through it. The CART Locale Recommendation Team has presented a priority-ordered set of recommended locales for the primary and supplementary sites, along with alternatives for each (Schwartz et al. 1991). The selection was based primarily on the following criteria: geographical and climatological homogeneity occurrence of climatologically important cloud types; seasonal change of surface properties variability of radiatively active atmospheric components synergism with other programs; and manageable logistics. An additional criterion was that, taken together, the set of recommended locales must span a broad range of climate regimes. The recommended primary locales include two land and three ocean locales. The first CART site will be established in the Southern Great Plains (SGP) of the United States. The next CART site to be established on land is to be in the polar regions, on the North Slope of Alaska (NSA).

27314 (CONF-9110336–, pp. 155-160) **Gulf stream locale - a field laboratory for cloud process.** Raman, S. (North Carolina

State Univ., Raleigh (US)). USDOE Office of Energy Research, Washington, DC (United States). Environmental Sciences Div. Dec 1992. From 2. Atmospheric Radiation Measurement (ARM) science team meeting; Denver, CO (United States); 26-30 Oct 1991. In *Proceedings of the second Atmospheric Radiation Measurement (ARM) Science Team Meeting.* 169p. Order Number DE93005886. Source: OSTI; NTIS; INIS.

The Guld Stream Locale is covered by clouds over 70% of the time. These clouds mainly consist of cumulus, stratocumulus, altostratus, and and alto-cumulus. Clouds associated with the Gulf Stream Locale are in general due to the cyclogenesis or redevelopments of the storms off the east coast of the United States in winters, movement along the coast of the storms that are generated over the Gulf of Mexico in the spring and fall and mesoscale convective circulations present in all seasons. During the summer and early fall this region is also susceptible to hurricanes moving from the south. The challenge is to devise a method to realistically incorporate the thermodynamic processes associated with these clouds in dynamic climate models. That would require a better understanding of the physical processes of clouds of different scales produced by different processes. The Gulf Stream Locale provides a test case for these processes since a finer resolution global climate model can resolve some of the predominant cloud features in this region. The Gulf Stream, responsible for the generation of the clouds, cannot be resolved explicitly in these models. One of the main ARM scientific issues to be addressed in this locale is the process of cloud formation, maintenance, and dissipation. It is important to parameterize the cloud processes properly so that the correct type of clouds with appropriate radiative properties are generated in a climate model. Parameterization is necessary because the processes responsible for the generation of clouds are micro and mesoscale. Other ARM scientific issues of relevance are surface turbulent fluxes of sensible and latent heat, surface inhomogeneity (in roughness, hydrology and heating), diurnal variations in surface energy budget, and the representations of the planetary boundary layer in large scale models.

27315 (CONF-930285–1) **Forest management for fixing and sequestering carbon.** Marland, G.; Dale, V.; Graham, R.; Luxmoore, R.; Marland, S.; McLaughlin, S.; Norby, R.; Post, W.M.; Tschaplinski, T.; Tuskan, J.; Wright, L. Oak Ridge National Lab., TN (United States). [1993]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 2. US/Japan workshop on global change research: environmental response technologies; Honolulu, HI (United States); 1-3 Feb 1993. Order Number DE93013520. Source: OSTI; NTIS; INIS; GPO Dep.

The concept of planting trees as part of a strategy to confront the possibility of global climate change is now widely accepted. As trees grow they remove CO_2 from the atmosphere and thus slow the atmospheric build-up of CO_2, an important greenhouse gas. Within the global-climate-change context, there are two fundamental problems with managing trees to store carbon. First, the magnitude of fossil-fuel related emissions of CO_2 is so large, 6 billion metric tons of carbon per year that it takes very large areas of tree planting to make a significant impact. Second, as trees mature their rate of growth, and hence rate of net carbon uptake, declines. lie large demand on land area suggests that there is a limit to the fraction of total CO_2 emissions that we might reasonably expect to offset with growing trees. The ultimate maturation of forests suggests that there is a limit on the length of time over which offsets are feasible and that we need to ask what to do as the rate of C uptake declines. Acknowledging a that the availability of land will constrain the ability of tree planting to offset industrial emissions of CO_2, we consider how the land which is available can be used most effectively. This report speculates on how much land might be available for a forest management strategy motivated (at least partially) by concerns about climate change, but our principal focus is on how a given land area can be best used to minimize net emissions of CO_2 and how much might be achieved on a unit of land. We do not suggest that carbon management should be the principal criteria for land management, but we discuss the implications if it were. Confronting global and local changes in climate will be one of many objectives in land management and we explore for the most effective strategy for pursuing this objective.

27316 (DOE/ER/60970–T1) **Monitoring the response of the upper troposphere/lower stratosphere to a greenhouse gas scenario: Final progress report, May 1, 1990–December 15, 1992.** Davis, J.M.; Cox, S.K. Colorado State Univ., Fort Collins, CO (United States). Dept. of Atmospheric Science. 15 Dec 1992. 22p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-90ER60970. Order Number DE93014509. Source: OSTI; NTIS; INIS; GPO Dep.

During the past two years a system has been under development to contribute to this monitoring process by making measurement of the downwelling infrared radiance field at moderate spectral resolution. Sensitivity of the measurements to the presence of cirrus cloudiness, and effective particle size in cirrus clouds has been demonstrated. Sensitivity of the measurements to concentration of $C0_2$ and to the gross temperature structure of a $2CO_2$ atmosphere have been modeled, and measurements have been made at various locations to provide a data base for further system evaluation. A temperature retrieval algorithm has been acquired and examined concerning its potential for monitoring temperature and gaseous concentration profiles. A continue research program is described herein that may be divided into three parts. First, continued system development must be pursued. This includes continued attention to the absolute accuracy of the measurements, and implementation of the Path Characterization Algorithm (retrieval code). Second, the value of long term deployment of the system at a site of considerable elevation is necessary. Third, inclusion of a solar transmission capability at moderate resolution is proposed.

27317 (DOE/ER/61012–T3) **Linkage of anthropogenic aerosol to clouds and climate: Progress report No. 3.** Hudson, J.G. Nevada Univ., Reno, NV (United States). Desert Research Inst. 14 Dec 1992. 24p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG08-90ER61012. Order Number DE93016434. Source: OSTI; NTIS; INIS; GPO Dep.

During the first year of this project equipment was built to obtain direct droplet measurement data from a mobile platform in fog (or mountain impacted stratum) and to characterize CCN according to particle volatility (thermal processing). Since the start date, July 15, 1990, was during the California stratus season and it was necessary to complete the construction of equipment and allow time before a field project it was not possible to begin field work until the summer of 1991. This report discusses surface measurements made in 1991 and 1992 as well as the SEAHUNT (Shiptrail Evolution Above High Updraft Naval Targets) Project and the ASTEX (Atlantic Stratocumulus Transition Experiment) Project.

27318 (DOE/ER/61014–3) **The role of clouds and oceans in global greenhouse warming: Part 1, Progress report.** Hoffert, M.I. New York Univ., NY (United States). Dept. of Applied Science. Dec 1992. 21p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-90ER61014. Order Number DE93016206. Source: OSTI; NTIS; INIS; GPO Dep.

During the past three years we have conducted several studies using models and a combination of satellite data, in situ meteorological and oceanic data, and paleoclimate reconstructions, under the DoE program, "Quantifying the Link Between Change in Radiative Balance and Atmospheric Temperature". Our goals were to investigate effects of global cloudiness variations on global climate and their implications for cloud feedback and continue development and application of NYU transient climate/ocean models, with emphasis on coupled effects of greenhouse warming and feedbacks by both the clouds and oceans. Our original research plan emphasized the use of cloud, surface temperature and ocean data sets interpreted by focused climate/ocean models to develop a cloud radiative forcing scenario for the past 100 years and to assess the transient climate response; to narrow key uncertainties in the system; and to identify those aspects of the climate system most likely to be affected by greenhouse warming over short, medium and long time scales.

27319 (DOE/ER/61056–T1) **The Department of Energy's Atmospheric Chemistry Program: A critical review.** National Academy of Sciences - National Research Council, Washington, DC (United States). 1991. 34p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-90ER61056. Order Number DE93015312. Source: OSTI; NTIS; INIS; GPO Dep.

In response to a request from the Department of Energy's (DOE) Office of Health and Environmental Research (OHER), the Committee on Atmospheric Chemistry has reviewed OHER's Atmospheric Chemistry Program (ACP). This report contains the committee's evaluation and critique arising from that review. The review process included a two-day symposium held at the National Academy of Sciences on September 25 and 26, 1990, that focused on presenting the ACP's current components, recent scientific accomplishments, and scientific plans. Following the symposium, committee members met in a one-day executive session to formulate and outline this report. In undertaking this review, OHER and ACP management requested that the committee attempt to answer several specific questions involving the program's technical capability and productivity, its leadership and organization, and its future direction. These questions are given in the Appendix. This report represents the committee's response to the questions posed in the Appendix. Chapter I explores the committee's view of the role that atmospheric chemistry could and should assume within the DOE and its prospective National Energy Strategy. Chapter 2 assesses the current ACP, Chapter 3 presents recommendations for revising and strengthening it, and Chapter 4 restates the committee's conclusions and recommendations.

27320 (DOE/ER/61474–1) **[An experimental regional scale climate simulation laboratory]: Year 1 progress letter.** Wisconsin Univ., Madison, WI (United States). [1993]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-92ER61474. Order Number DE93015935. Source: OSTI; NTIS; GPO Dep.

The major focus of this CHAMMP science team project is the development and in-model testing of new numerical methods and dynamical algorithms which are particularly well suited to massively parallel computers. The project includes efforts relevant to both global ocean circulation models and atmospheric General Circulation Models GCMS. During the first year of the project we have been focusing on two basic areas. The first of these is the implementation and testing of a global non-linear dynamics code using the Local Spectral (LS) formalism. During the first year of the CHAMMP project we have been focusing on developing an efficient parallel implementation of a spherical LS code on a massively parallel computer. Our initial implementation platform has been the Thinking Machines CM5 system. We have completed an initial implementation of the LS system on the CM5 using a semi-spectral partitioning where the convolution sums in the LS kernel are computed using direct convolutions in the meridional direction and FFT based fast convolutions are performed using the Winnograd method in the zonal direction. A second element of the first year effort has been the evaluation of alternate dynamical systems for use in global ocean circulation models. In this area we have concentrated our efforts on parabolic non-hydrostatic systems using artificial compressibility.

27321 (DOE/FTR–93011423) **[A trip to Krakow, Poland to investigate their clean fossil fuels and energy efficiency program]: Foreign trip report, November 6–15, 1992.** Gyorke, D.F.; Mundorf, W.; Lebetz, D.; Russial, T. USDOE Pittsburgh Energy Technology Center, PA (United States). 4 Dec 1992. 15p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93011423. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Douglas Gyorke (US DOE/PETC; 412/892-6173), William Mundorf (US DOE/PETC; 412/892-4483), Donna Lebetz (US DOE/PETC; 412/892-6206), and Thomas Russial (US DOE/PETC; 412/892-4630) visited Krakow, Poland, on November 6–15, 1992. The purpose of this visit was to conduct a pre-proposal conference for Program Opportunity Notice (PON), DE-PN22-92PC92178, and to participate in the seminars for US and Polish firms arranged by the Bilateral Steering Committee (BSC) for the Krakow Clean Fossil Fuels and Energy Efficiency Program. The Program addresses approximately 1,350 small boiler houses and 125,000 home heating stoves in Krakow that have been identified as being significant sources of atmospheric pollution, and includes five subprojects that represent various approaches to pollution reduction. If subprojects demonstrate commercial viability relative to a free market in Poland, they could lead to the formation of various Polish/American joint ventures to supply equipment or fuels to reduce gaseous and particulate emissions in the Krakow area. The five designated subprojects are: 1. District Heating 2. Replacement by Natural Gas 3. Electric Heating 4. Boiler Houses 5. House Stoves. The Program is being conducted in three phases: I. Data gathering; II. Communication of information on the Program to interested US companies; and III. Solicitation for US companies to form businesses in Poland to supply equipment and/or services to reduce emissions in the Krakow area.

27322 (DOE/FTR–93012978) **Travel to France and Germany to present a paper and attend IAU/ICSU/UNESCO exposition on the adverse environmental impacts on astronomy and attend workshop at IFU/FhG: Foreign trip report, June 26–July 12, 1992.** Laulainen, N.S. Pacific Northwest Lab., Richland, WA (United States). 7 Aug 1992. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93012978. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The objective of the IAU/ICSU/UNESCO Exposition in Paris was to inform government officials, professional and amateur astronomers, and science writers of the increasingly serious adverse impacts of environmental conditions on the science of astronomy and to draft a declaration (attached) on the reduction of these environmental impacts for urging action by UNESCO and ICSU. The traveler's role at the meeting was to present a paper on atmospheric light extinction and to get information on the availability of measurements of light extinction obtained by astronomers. The Fraunhofer Institute in Garmisch (IFU) has a central role in defining, planning, and conducting environmental and climate research programs for the German Federal Ministry of Science and Technology and the Ministry of Environment. The traveler's role at the workshop on aircraft measurements to study temporal changes in the concentration and deposition of atmospheric pollutants was to assist in defining appropriate aircraft measurements. I also presented a seminar on atmospheric light extinction and promoted collaborative work.

27323 (DOE/FTR–93013121) **[Travel to Austria for a conference on visibility and fine particles]: Foreign trip report, September 13–20, 1992.** Laulainen, N.S. Pacific Northwest Lab., Richland, WA (United States). 13 Oct 1992. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93013121. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The objective of the Conference on Visibility and Fine Particles in Vienna was to bring together internationally renown visibility and aerosol scientists to deal with all aspects of atmospheric aerosol particles, including their interaction with light, degradation of visual air quality, their origin and the processes leading to their formation in the atmosphere, and the effectiveness of air pollution strategies on the improvement of visual air quality. Several sessions were particularly relevant to the DOE Visibility Assessment work, including those on aerosol formation and relative humidity response, the relative contributions of aerosol light scattering and light absorption to visibility impairment, the characterization of natural/non-energy background aerosols and visibility impairment, and perceptibility of visual air quality changes.

27324 (DOE/ID–10432) **Air emission inventory for the Idaho National Engineering Laboratory: Final report.** Allen, P.H. EG and G Idaho, Inc., Idaho Falls, ID (United States). Mar 1991. 504p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. (INEL/MISC–93065). Order Number DE93013749. Source: OSTI; NTIS; GPO Dep.

During the fall of 1989, an Air Emission Inventory was initiated at the Idaho National Engineering Laboratory (INEL). This inventory was undertaken in part at the request of the State of Idaho Air Quality Bureau (IAQB) so that the emission of air contaminants from the INEL could be quantified and this information used when future air permits are evaluated. The INEL would also benefit by: enabling preparation of an application for a site-wide permit to operate, facilitating preparation of other air permits, and allowing the INEL management to track and receive credit for facilities that are being phased out. The air contaminants that are included in this inventory are the Criteria Pollutants (Nitrogen Oxides, Sulfur Oxides, Carbon Monoxide, Volatile Organic Compounds, Lead, and PM10),

and Radionuclides. For this inventory, all particulate (TSP) is considered to be PM10, but will be differentiated in the Toxic Air Pollutant inventory that INEL will prepare over the next year. It is important to note that many of the terms used in this document are not used as defined in the regulations for the control of air pollution. Terms such as major, minor, and significant with regards to emissions are used as relational terms to the inventory, rather than descriptive of regulatory concepts. When this information is used for permitting purposes, these terms will be reserved for their regulatory meanings.

27325 (DOE/ID–10433) **Air Emission Inventory for the Idaho National Engineering Laboratory: 1990 and 1991 emissions report.** Stirrup, T.S. EG and G Idaho, Inc., Idaho Falls, ID (United States). Jun 1992. 599p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. (INEL/MISC–93066). Order Number DE93013730. Source: OSTI; NTIS; GPO Dep.

During the fall of 1989, the Air Emission Inventory (AEI) was initiated at the Idaho National Engineering Laboratory (INEL). This inventory was undertaken in part at the request of the State of Idaho Air Quality Bureau (IAQB). The request was to provide a mechanism so the emission of air contaminants from the INEL could be quantified and this information used when future air permits are evaluated. The pollutants associated with the inventory include nitrogen oxides, sulfur oxides, carbon monoxide, volatile organic compounds, lead, and particulates as well as radionuclides. For the inventory, all particulate (TSP) is considered to be PM10, but will be differentiated in the INEL Toxic Air Pollutant Inventory which DOE-ID is presently preparing for submittal to the State. For the purposes of this report, only the criteria pollutants and radionuclides are reported; any noncriteria pollutants will be addressed as required.

27326 (EGG–11265-4001) **The Atmospheric Release Advisory Capability Site Workstation System.** Foster, K.T. (Lawrence Livermore National Lab., CA (United States)); Sumikawa, D.A.; Foster, C.S.; Baskett, R.L. Lawrence Livermore National Lab., CA (United States); EG and G Energy Measurements, Inc., Pleasanton, CA (United States). [1993]. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC08-93NV11265 ;W-7405-ENG-48. (CONF-930810–1: Topical meeting on environmental transport and dosimetry, Charleston, SC (United States), 31 Aug - 3 sep 1993). Order Number DE93011032. Source: OSTI; NTIS; INIS; GPO Dep.

The Atmospheric Release Advisory Capability (ARAC) is a centralized emergency response service that assesses the consequences that may result from an atmospheric release of toxic material. ARAC was developed by the Lawrence Livermore National Laboratory (LLNL) for the Departments of Energy (DOE) and Defense (DOD) and responds principally to radiological accidents. ARAC provides radiological health and safety guidance to decision makers in the form of computer-generated estimates of the effects of an actual, or potential release of radioactive material into the atmosphere. Upon receipt of the release scenario, the ARAC assessment staff extracts meteorological, topographic, and geographic data from resident world-wide databases for use in complex, three-dimensional transport and diffusion models. These dispersion models generate air concentration (or dose) and ground deposition contour plots showing estimates of the contamination patterns produced as the toxic material is carried by the prevailing winds. To facilitate the ARAC response to a release from specific DOE and DOD sites and to provide these sites with a local emergency response tool, a remote Site Workstation System (SWS) is being placed at various ARAC-supported facilities across the country.. This SWS replaces the existing antiquated ARAC Site System now installed at many of these sites. The new system gives users access to complex atmospheric dispersion models that may be run either by the ARAC staff at LLNL, or (in a later phase of the system) by site personnel using the computational resources of the SWS. Supporting this primary function are a variety of SWS-resident supplemental capabilities that include meteorological data acquisition, manipulation of release-specific databases, computer-based communications, and the use of a simpler Gaussian trajectory puff model that is based on Environmental Protection Agency's INPUFF code.

27327 (ENEA-RT-AMB–91-11) **Global climate change modelling.** Vialetto, G. ENEA, Casaccia (Italy). Area Energia Ambiente e Salute. Apr 1991. 51p. (In Italian). (RT/AMB–91-11). Order Number DE93799202. Source: OSTI; NTIS (US Sales Only).

Concern for the increasing concentrations of carbon dioxide and other greenhouse gases in the atmosphere is at the root of the flourishing of studies and research aimed at answering if this phenomenon is actually able to cause global climate changes. Many studies are based on models that are able to simulate the climate system and to produce predictions of future climatic trends. This paper describes a methodology for studying climate and global changes based on the use of a climate model. A classification of models that have been used is also proposed. This paper briefly reviews how these models are being used and the kind of experiments that have been developed in the latter studies. Particular attention is given to the studies representing the current trend of the research in climate change modelling.

27328 (ENEA-RT-AMB–91-25) **Plycyclic aromatic hydrocarbon concentrations in urban air particulates: Sampling in 18 Italian cities.** Di Palo, C.; Chiavarini, S.; Zamora, P. ENEA, Casaccia (Italy). Area Energia Ambiente e Salute. Sep 1991. 24p. (In Italian). (RT/AMB–91-25). Order Number DE93799222. Source: OSTI; NTIS (US Sales Only).

Polycyclic Aromatic Hydrocarbons (PAHs), ubiquitous in the environment are emitted into the atmosphere (mainly from the incomplete combustion of fossil fuels) as adsorbates on dust particles and aerosols. Many PAHs have been shown to be potent carcinogens and mutagens in biological assays, and it is therefore not surprising that their concentration in the air is monitored in many cities throughout the world. In this work, the concentration of fourteen PAHs were measured in the respirable fraction (<10 microns of aerodynamic diameter) of the suspended particulate matter in eighteen Italian cities, during the 'Treno Verde' campaign. The samples, collected by high volume samplers, were extracted in a Soxhlet apparatus, cleaned and fractionated by silica gel column chromatography and analyzed by GC-MS operating in SIM (selected ion monitoring mode) and HPLC with spectrofluorimetric detection. In this paper, a tentative correlation of the analytical results is proposed with concentration data for particulate matter, NOx, hydrocarbons and CO. By means of the ratios of benzo(a)pyrene (B(a)P) to benzo(ghi)perylene and of pyrene to B(a)P, the possibility of establishing the source of the PAHs is indicated.

27329 (ENEA-RT-DISP–92-01) **TRIAS code for groundwater flow and solute transport calculations.** Paris, P. ENEA, Rome (Italy). Direzione Sicurezza Nazionale e Protezione Sanitaria. Jun 1992. 32p. (In Italian). (RT/DISP–92-01). Order Number DE93799245. Source: OSTI; NTIS (US Sales Only); INIS.

TRIAS is an analytical groundwater flow and solute transport mode that simulates saturated flow in a phreatic aquifer at steady-state conditions and solute transport in transient conditions for instantaneous and permanent sources and for hazardous waste landfill releases. TRIAS is specially useful in those situations where the scarsity of data does not allow for a more detailed characterization of the aquifer. For example, it may be used for the preliminary qualification of a waste disposal site, evaluating its capability to limit pollutant concentrations. TRIAS features a complete user interface with screen menus and on-line help facilities that provide comprehensive support to users. Graphic outputs are provided for both the groundwater head and concentration distributions.

27330 (ETDE/JP-mf–93798681, pp. 46-53) **Global air pollution and its preventive measures.** Ando, J. (Chuo University, Tokyo (Japan). Faculty of Science and Engineering). 20 Jan 1993. 94p. (In Japanese). In *Symposium on global environmental conservation and air pollution prevention technology.* Order Number DE93798681. Source: OSTI; NTIS (US Sales Only).

This paper explains the current situation of global air pollution and its preventive measures, using various tables and statistics. They may be summarized as follows: artificial generation of SO2 and NOx has been decreased in industrialized countries, and is

beginning to increase in developing countries; Germany uses more rigorous standards of NOx emission than Japan; Japan has stack gas desulfurization equipment next to the U.S.A. in capacity, but largest in number in the world; rains in the north and central parts of China have high pH, which leaves concerns in Japan about its future effects; acid rain has caused acidification of lakes remarkably in North Europe and North America, but not in Japan and China; most of the stack gas desulfurization facilities uses limestone as an absorbent to produce gypsum in Japan and Europe, and disposable sludge in the U.S.A.; Taiwan has adopted the magnesia process; a cost comparison indicates that combustion improvements or in-furnace denitrification is inexpensive for reducing NOx emission, but denitrification is expensive; and using coals applied with sufficient pollution control measures is less expensive than using oil. 18 figs., 13 tabs.

27331 (ETDE/JP-mf–93798681, pp. 89-94) **Current situation in CO2 membrane separation technologies.** Ninomiya, K. (Ube Industries, Ltd., Yamaguchi (Japan)). 20 Jan 1993. 94p. (In Japanese). In *Symposium on global environmental conservation and air pollution prevention technology.* Order Number DE93798681. Source: OSTI; NTIS (US Sales Only).

Expectations are given on membrane separation technologies as measures to solve environmental CO2 problems. This paper describes membrane performance required in recovering CO2 contained in combustion exhaust gases, and applicability of the technologies to actual scenes. Separation membranes are required of having fast permeation velocities and high separation rates α ratio of (permeation coefficients). Most of membranes being used practically (for H2-O2 separation) are organic membranes. Membranes with fast permeation velocity include polyallylene oxide membranes and aromatic polyimide membranes, but their separation rates are low. Generally they are in a trade-off relation. Module types may include flat membrane laminate, spiral, and hollow fiber systems, all requiring techniques to manufacture membranes with large area for treating a large amount of CO2. According to a trial calculation assuming the CO2 recovery rate of 60%, an attempt of recovering 95% CO2 requires nearly impossible separation rate α, but there would be a possibility if combined with liquefied coal recovery or if two-step membranes are used. 2 refs., 4 figs., 2 tabs.

27332 (INIS-mf–13543) **Conference on provisions against radon: Proceedings.** Ministerstvo Zivotniho Prostredi, Prague (Czech Republic); Okresni Urad, Jihlava (Czech Republic); Dum Kultury Odboru, Jihlava (Czech Republic). 1992. [232p.] (In Czech, Slovak). (CONF-9211241–: Conference on provisions against radon, Jihlava (Czech Republic), 23-25 Nov 1992). Order Number DE93629294. Source: OSTI; NTIS (US Sales Only); INIS.

The Proceedings contain 20 contributions dealing with diverse aspects of the radon problem. Information is presented on the occurrence of radon on the territory of Czechoslovakia, and on natural radioactivity of rocks. The majority of contributions concentrate on ways of radon measurement, on determination of the radon content of building materials and on radon propagation through buildings. Various technologies for removing radon from homes and for preventing radon leaks are described and assessed. The effect of radon on human health is also dealt with. (M.D.). 16 tabs., 34 figs., 39 refs.

27333 (INIS-mf–13543, pp. 1-5) **Radon risk maps - correct applications.** Barnet, I. (Ustredni Ustav Geologicky, Prague (Czech Republic)). Ministerstvo Zivotniho Prostredi, Prague (Czech Republic); Okresni Urad, Jihlava (Czech Republic); Dum Kultury Odboru, Jihlava (Czech Republic). 1992. (In Czech). (CONF-9211241–: Conference on provisions against radon, Jihlava (Czech Republic), 23-25 Nov 1992). In *Conference on provisions against radon: Proceedings.* [232p.] Order Number DE93629294. Source: OSTI; NTIS (US Sales Only); INIS.

The Czech Republic has been surveyed for radon risk, and maps on the 1:200 000 scale have been set up based on results of field measurements of the volume activity of radon in soil air (4 800 measurements in total). The maps are used in territorial planning, in setting up strategies for financing remedial actions and in determining priorities for radon monitoring in buildings and in drinking water. The radon pathway from a rock is affected by soil permeability, tectonic defects and climatic factors. The radon risk assessment, however, cannot rely on regional maps solely; additional, more detailed measurements are necessary. (M.D.). 2 tabs., 3 refs.

27334 (INIS-mf–13543, pp. 23-31) **Radon monitoring in general.** Hulka, J. (Krajska Hygienicka Stanice, Hradec Kralove (Czech Republic). Oddeleni Hygieny Zareni). Ministerstvo Zivotniho Prostredi, Prague (Czech Republic); Okresni Urad, Jihlava (Czech Republic); Dum Kultury Odboru, Jihlava (Czech Republic). 1992. (In Czech). (CONF-9211241–: Conference on provisions against radon, Jihlava (Czech Republic), 23-25 Nov 1992). In *Conference on provisions against radon: Proceedings.* [232p.] Order Number DE93629294. Source: OSTI; NTIS (US Sales Only); INIS.

The problems of radon measurement in buildings and rooms is dealt with in detail. The radon content of air varies in time, in dependence on the way of airing and on the difference between the indoor and outdoor temperatures. It also varies in space, which is determined by whether the radon source in the room is a point source and whether the ventilation is efficient. Values averaged over a long period of time or measurement of the radon input to the building must be applied to obtain unbiased data. Track detectors are used to perform the basic survey of existing buildings. Detailed radon diagnostics is aimed at finding particular radon sources. (M.D.). 2 figs.

27335 (INIS-mf–13543, pp. 71-78) **Evaluation of radon risk from the subsoil.** Kulajta, V. (Radium s.r.o., Liberec (Czechoslovakia)). Ministerstvo Zivotniho Prostredi, Prague (Czech Republic); Okresni Urad, Jihlava (Czech Republic); Dum Kultury Odboru, Jihlava (Czech Republic). 1992. (In Czech). (CONF-9211241–: Conference on provisions against radon, Jihlava (Czech Republic), 23-25 Nov 1992). In *Conference on provisions against radon: Proceedings.* [232p.] Order Number DE93629294. Source: OSTI; NTIS (US Sales Only); INIS.

The principles of radon risk measurement and evaluation are given, as follow from health physics instructions and practical experience. The determination of the volume activity of ^{222}Rn in soil air at 0.6-0.8 m depths is the basic surveying method. The results are affected by the climatic conditions and by the sampling technology. A method of detailed radon survey of building plots is described. The radon risk categories for building areas combine the radon occurrence in the subsoil, volume activity of soil air and permeability of the soils and rocks to gases. (M.D.). 2 tabs., 5 refs.

27336 (INIS-mf–13543, pp. 79-85) **Radon propagation through buildings.** Dousa, P. (Institut Hygieny a Epidemiologie, Prague (Czech Republic)). Ministerstvo Zivotniho Prostredi, Prague (Czech Republic); Okresni Urad, Jihlava (Czech Republic); Dum Kultury Odboru, Jihlava (Czech Republic). 1992. (In Czech). (CONF-9211241–: Conference on provisions against radon, Jihlava (Czech Republic), 23-25 Nov 1992). In *Conference on provisions against radon: Proceedings.* [232p.] Order Number DE93629294. Source: OSTI; NTIS (US Sales Only); INIS.

Mathematical formulas describing the diffusion of radon through building material layers, and the diffusion and flow of radon through cracks in the layers are given. Air flow, which is responsible for 97% indoor radon transfer, arises from temperature differences indoors and outdoors as well as between the rooms. In winter, when the homes are heated, the houses behave like stacks sucking in air from the subsoil. The kind of floor has a major effect on indoor radon activity. (M.D.). 3 figs., 1 tab., 2 refs.

27337 (INIS-mf–13543, pp. 86-94) **Radon survey in the Jihlava district.** Wasserbauer, S. (Okresni Hygienicka Stanice, Jihlava (Czechoslovakia)); Novotny, Z. Ministerstvo Zivotniho Prostredi, Prague (Czech Republic); Okresni Urad, Jihlava (Czech Republic); Dum Kultury Odboru, Jihlava (Czech Republic). 1992. (In Czech). (CONF-9211241–: Conference on provisions against radon, Jihlava (Czech Republic), 23-25 Nov 1992). In *Conference on provisions against radon: Proceedings.* [232p.] Order Number DE93629294. Source: OSTI; NTIS (US Sales Only); INIS.

The radon activity in drinking water exceeds the maximum permissible value fivefold at many sites in the Jihlava district. The radon risk has been monitored there since 1991. Track detectors evaluating the annual exposure are installed in buildings. Work on a detailed study of the public health status is in progress. Design

documentation of new buildings to be constructed within the district must include results of soil radon measurement. (M.D.). 4 figs.

27338 (INIS-mf–13543, pp. 119-127) **Physics underlying the searching for radon sources in houses.** Thomas, J. (Institut Hygieny a Epidemiologie, Prague (Czech Republic)). Ministerstvo Zivotniho Prostredi, Prague (Czech Republic); Okresni Urad, Jihlava (Czech Republic); Dum Kultury Odboru, Jihlava (Czech Republic). 1992. (In Czech). (CONF-9211241–: Conference on provisions against radon, Jihlava (Czech Republic), 23-25 Nov 1992). In *Conference on provisions against radon: Proceedings.* [232p.] Order Number DE93629294. Source: OSTI; NTIS (US Sales Only); INIS.

The radon diagnostics of houses is briefly outlined. The aim of radon diagnostics consists in the identification of radon sources (subsoil, building material, water), location of the main and side pathways of radon inlet in the building, quantification of the amounts of radon passing through the pathways and spreading through the house. The stack effect of radon suction from the subsoil into the building due to the temperature difference or underpressure caused by wind is described. The radon risk is different in the different seasons of the year and also varies throughout the day. Good diagnosis of radon transfer into a house requires a great deal of skill. (M.D.). 1 fig.

27339 (INIS-mf–13543, pp. 153-160) **Detailed survey of buildings as a targeted system of test procedures.** Breda, M. (Centrum Stavebniho Inzenyrstvi, Praha (Czechoslovakia)); Kilian, V. Ministerstvo Zivotniho Prostredi, Prague (Czech Republic); Okresni Urad, Jihlava (Czech Republic); Dum Kultury Odboru, Jihlava (Czech Republic). 1992. (In Czech). (CONF-9211241–: Conference on provisions against radon, Jihlava (Czech Republic), 23-25 Nov 1992). In *Conference on provisions against radon: Proceedings.* [232p.] Order Number DE93629294. Source: OSTI; NTIS (US Sales Only); INIS.

Recommendations for radon measurements in buildings are given. The survey begins by interviewing the householder and studying the technical documentation. Relative determination of the gamma dose rate and of the amount of radon and examination of the air replacement patterns follow. Finally, TLD dosemeters and radon monitors are installed and building material samples are taken for analysis. (M.D.).

27340 (INIS-mf–13543, pp. 211-218) **Radon in the interior of building structures and the sick building syndrome.** Senitkova, I. (Stavebna Fakulta TU, Kosice (Czechoslovakia)); Dobiasova, N. Ministerstvo Zivotniho Prostredi, Prague (Czech Republic); Okresni Urad, Jihlava (Czech Republic); Dum Kultury Odboru, Jihlava (Czech Republic). 1992. (In Slovak). (CONF-9211241–: Conference on provisions against radon, Jihlava (Czech Republic), 23-25 Nov 1992). In *Conference on provisions against radon: Proceedings.* [232p.] Order Number DE93629294. Source: OSTI; NTIS (US Sales Only); INIS.

The resulting volume activity of radon in air in a room is determined by the rate of radon emanation and by the intensity of airing. The risk is aggravated by the tendency to seal windows in order to save heat, and to manufacture building materials from raw materials which contain elevated amounts of radionuclides. Track detectors revealed that the equivalent volume activity of radon in homes is at a level of 50 Bq/m^3. This is below the highest permissible limit and poses no problem. Problems emerge in rooms where people smoke, because cigarette smoke also contains radon daughter products. (M.D.). 3 figs., 14 refs.

27341 (INIS-mf–13561) **Some improvement of charcoal measurement techniques used for indoor radon measurements in Qatar.** Arafa, W.M.; Alneimi, H.; Al-Houty, L.; About-Leila, H. Qatar Univ., Doha (Qatar). Dept. of Physics; Scientific and Applied Research Center (SARC), Doha (Qatar). [1993]. [14p.] Order Number DE93630670. Source: OSTI; NTIS (US Sales Only); INIS.

Some improvements on charcoal measurement techniques of Rn concentration are suggested. The detection efficiency is increased by using two scintillation detectors instead of commonly used one detector. The optimum exposure time to achieve the best detection accuracy and the lowest minimum detectable level was estimated and found to be of the order of four days. (author).

27342 (IVL-B–1064) **Atmospheric chemical model study of thermal and marine initiation of formation of oxidants at swedish conditions.** Andersson-Skoeld, Y.; Moldanova, J. Swedish Environmental Research Inst., Goeteborg (Sweden). Jun 1992. 28 p.p. (In Swedish). Order Number DE93500683. Source: OSTI; NTIS.

The influence of sea salt particles on oxidant formation has been studied with an atmospheric trajectory model. The results indicate that chlorine formation from sea salt particles in polluted air, with high concentrations of nitrogen oxides and ozone, increase the chemical activity in the atmosphere. The processes responsible can be of great importance in coastal areas with simultaneous emissions of nitrogen oxides and other ozone producing species. The atmospheric influence of the reactions of the nitrate radical with organic species has been studied. The reactions act as a buffer of the chemical activity in the troposphere. The reactions, however, produce increased amounts of organic nitrates and nitrogen dioxide. (7 refs., 19 figs.).

27343 (IVL-B–1079) **Deposition and effects of air pollutants I south and central Sweden.** Westling, O.; Hallgren Larsson, E.; Sjoeblad, K.; Loevblad, G. Swedish Environmental Research Inst., Lammhult (Sweden). IVL-Aneboda. Nov 1992. 109p. (In Swedish). Order Number DE93500686. Source: OSTI; NTIS.

The regional monitoring data on the deposition of acidifying compounds, sulphur and nitrogen, in twelve counties of southern and central Sweden has been evaluated. This base programme involves the collection of deposition in open field and in forest stands at 91 locations with spruce, pine or deciduous vegetation. The effect of acid deposition on the forest ecosystems are described by the chemistry of soilwater from below the vegetative zone in the soils. For most of the study sites, data on needle loss, forest growth, and soil chemistry is also available. Data on needle chemistry is available for the study sites in southwestern Sweden. All available data is combined in a computer database for correlation and evaluation processing. The evaluation shows that regional deposition monitoring depicts the size and distributional pattern of the fallout of sulphur and seasalts well. The monitoring of nitrogen can identify certain regions in southern Sweden that receive a heavy load of nitrogen. Soilwater analyses indicate that large areas in Sweden have heavily acidified forest soils, with low pH values, raised levels of magnesium, calcium, potassium, and high levels of inorganic aluminium. Forest sites, in the coastal regions of southern and southwestern Sweden even have raised inorganic nitrogen levels in soilwater. This evaluation shows a number of statistical methods by which the various data, produced by regional deposition monitoring, can be linked together. Following the recommendations on future monitoring of long-range transported pollutants and the quality of the forest soils by the authorities, the base monitoring programme continues. Deposition monitoring should be completed with the analysis of base cations: calcium, magnesium, sodium and potassium. The possibility to include measurements of nutrients in needles and leaves, and the amount of lichens and algal growth on the trees should be considered. (70 figs., 7 tabs.).

27344 (LA-UR–93-1797) **Numerical simulation of atmospheric dispersion in the vicinity of the Rocky Flats plant.** Bossert, J.E.; Poulos, G.S. Los Alamos National Lab., NM (United States). [1993]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930810–3: Topical meeting on environmental transport and dosimetry, Charleston, SC (United States), 31 Aug - 3 sep 1993). Order Number DE93014562. Source: OSTI; NTIS; INIS; GPO Dep.

The Atmospheric Studies in Complex Terrain (ASCOT) program sponsored a field experiment in the winter of 1991 near Rocky Flats, Colorado. Both meteorological and tracer dispersion measurements were taken. These two data sets provided an opportunity to investigate the influence of terrain-generated, radiatively-driven flows on the dispersion of the tracer. In this study, we use the Regional Atmospheric Modeling System (RAMS) to simulate meteorological conditions and tracer dispersion on the case night of 4–5 February 1991. The simulations were developed to examine the influence of nocturnal drainage flow from various topography regimes on the dispersion of tracer from the Rocky

Flats plant. The simulation described herein demonstrates the extent to which Rocky Mountain drainage winds influence the flow at the mountain/plain interface for a particular case night, and shows the potential importance of canyon drainage on dispersion from the Rocky Flats area.

27345 (LUTMDN-TMVK–5219) **Passive smoke evacuation systems - with reference to Vietnamese multi-storey buildings.** Gustavsson, Irene; Johansson, Anneli. Lund Univ. (Sweden). Dept. of Heat and Power Engineering. Feb 1993. 97p. Order Number DE93500695. Source: OSTI; NTIS.

Examination paper.

The use of indoor combustion devices without proper smoke evacuation is a severe problem in Vietnam, as in many other developing countries. This study is focusing on a solution with a passive design of the smoke evacuation system. In order to form a knowledge basis a field survey concerning kitchen environments was carried out in Hanoi with surroundings. The only way to discharge the smoke to the outside of the house, in a passive way, is to use the natural buoyancy of the hot gases produced during the combustion. It is difficult to reach efficiency in this mechanism - the chimney draught - when using an open fire and in a climate where there is no difference between the indoor and the outdoor temperature. Experiments were performed in Hanoi, in order to see in what way different parameters influenced the draught. An experimental chimney hood was constructed and a number of measurement series were performed and during those the CO-concentration, the particle concentration, and the temperature in the flue pipe were measured. The experiments showed large differences between identical series, which makes it difficult to estimate the influence of the draught. Our conclusion is that it is necessary to use a small smoke gas fan in the flue pipe, in combination with sheltering walls around the fire, if an essential improvement of the indoor environment should be reached.

27346 (NEI-DK–1216) **Atmospheric deposition: 1991 monitoring programme included in the water environment plan.** Faglig rapport fra DMU, 59. Hovmand, M.F.; Grundahl, L.; Kemp, K. Danmarks Miljoeundersoegelser, Roskilde (Denmark). Afd. for Forureningskilder af Luftforurening. Nov 1992. 96p. (In Danish). Order Number DE93500359. Source: OSTI; NTIS.

Atmospheric deposition of nitrogen compounds over the countryside has had a significant influence on plant production in such a way that the addition of nitrogen in woods, heaths and high-lying bogs is the main source of nitrogen supply to the plant communities. The atmospheric conveyance of this nitrogen to Danish inner channels is the main concern of the study. Deposition in the form of rain and of gases and particles is measured from 17 measurement stations. This constitutes between one quarter and one third of the total amount of added nitrogen to Danish inner waters. The results of these measurements are presented. It is concluded from these continuous measurements over the past three years that the atmospheric content of nitrogen dioxide, ammonia and nitrate is partly the result of long-distance transport, mainly by southerly and westerly winds, though ammonia also originates from local Danish sources, especially from farming areas. Sulfur dioxide and sulfates appear to be blown over from sources in Eastern Europe. Sulfur compounds are of special significance with regard to soil acidification. Heavy metals have contributed to the general contamination of land and marine areas. (AB) (23 refs.).

27347 (NEI-DK–1224) **Refrigeration systems with CFC refrigerants: Main report.** Aagaard, H.C.; Bay Moeller, L. Dansk Teknologisk Inst., Taastrup (Denmark). Energiteknologi. Jan 1993. 86 p.p. (In Danish). Order Number DE93500375. Source: OSTI; NTIS.

In 1988, the main project entitled "Refrigeration systems with CFC refrigerants" was established in cooperation with the Danish Energy Agency. The area consists of problems regarding collection, cleansing and recycling related to refrigerating equipment, as well as the use of CFC refrigerants in refrigeration plants, and whether this should be stopped. The six projects, are composed in such a way that they each deal with a specific subject, under one main heading. This publication contains the synopsis report based on the following projects: Regeneration of CFC (R12) and recycling of regenerated CFC for refrigeration purposes (concluded April 1990). Collection and treatment. Examination of equipment for collecting and/or cleansing refrigerants. Recycling possibilities for used CFC. Control of consumption of refrigerants, and Alternative refrigerants for cooling and heat pump systems. The purposes of the projects are given in addition to a synopsis of each one and their conclusions as well as a brief description of how each one was carried out. (AB).

27348 (NEI-DK–1225) **Refrigeration systems with CFC refrigerants: Report no. 2. Collection and treatment.** Martens, P. Dansk Teknologisk Inst., Taastrup (Denmark). Energiteknologi. Jan 1993. 67p. (In Danish). Order Number DE93500377. Source: OSTI; NTIS.

The project comprised the registration of methods and procedures as regards using and handling CFC refrigerants and an analysis of existing methods with regard to future demands for reduction of spillage as well as proposals for procedures which will ensure uniform handling of both present and future refrigerants. The methods described cover the filling, emptying and handling of refrigerant containers including transport. Filling up refrigeration systems can take place either directly from refrigerant containers, possibly by using refrigerant pump or compressor by using a filling glass according to the same principle or by filling up via a filling station. Emptying of refrigeration system or refrigerant is relevant in connection with service, reconstruction and repair or when the refrigeration system is being scrapped. A system has been established with refrigeration containers for used/polluted refrigerants. There is at present no alternative to the filling method used until now. In order to avoid rinsing, evacuation could be made both from the inlet side and the pressure side. It can be necessary to rinse the filling pipes with the refrigerant in order to avoid "mix" or separate filling equipment can be used for each refrigerant. It is no longer usual to let the filling blow out into the open air. The refrigerant is tapped from the evacuation aggregate into the refrigerant containers. If it is intended to recycle a large percentage of the refrigerant collected, a separate refrigerant container must be used for each refrigerant type. The circulation of containers between the producer, wholesaler, refrigerant manufacturer is illustrated in route diagrams. (AB).

27349 (NEI-DK–1226) **Refrigeration systems with CFC refrigerants: Report no. 3. Examination of equipment for collecting and/or cleansing refrigerants.** Bay Moeller, L.; Madsboell, H. Dansk Teknologisk Inst., Taastrup (Denmark). Energiteknologi. Jan 1993. 92 p.p. (In Danish). Order Number DE93500381. Source: OSTI; NTIS.

In connection with reuse of existing CFC refrigerants, it is necessary to know the possibilities for catching and regenerating the drained of refrigerant by means of available equipment. This mainly involves units that can drain off the refrigerant from a system for reuse or destruction, prepare the refrigerant for reuse or prepare the refrigerant for reuse with specifications corresponding with the new refrigerant. Tests were carried out on units intended for cleaning and regeneration. A market research survey showed a preponderance of mobile units that could drain cooling plants and clean the drained refrigerant. The mobile units are typically assembled with small built-in refrigerant vessels, drying filter, filter for chlorine ions, oil separator, and in some cases a system for ventilation of non-condensable gasses. Only few very large units are marketed that claim be able to regenerate the refrigerant. The test were carried out on a refrigerant sample consisting of CFC 12 added given amounts of mineral oils, demineralized water, atmospheric air, hydrochloric acid, and HCFC 22, using Danish produced A'Gramkow and Christonik equipment. Results showed that the tested units can purify CFC 12 of the polluting substances water and hydrochloric acid and that one of the units can purify the mineral oil so that it is close to the standard of a new refrigerant. For the other unit, the content of oil in the cleaned refrigerant was clearly above the requirements of the standard. Neither unit could remove the HCFC 22. (AB).

27350 (NEI-DK–1227) **Refrigeration systems with CFC refrigerants: Report no. 4. Recycling possibilities for used CFC.** Bay Moeller, L. Dansk Teknologisk Inst., Taastrup (Denmark). Energiteknologi. Jan 1993. 87p. (In Danish). Order Number DE93500383. Source: OSTI; NTIS.

The technical conditions regarding possibilities for recycling CFC are investigated, and demands on the refrigerant quality for recycling are stated. In general, the investigation has shown that while there is a new CFC refrigerant available on the market in sufficient amounts and at reasonable prices, and an efficient organization for collection of drained refrigerant has not been formed, it will be difficult to motivate the refrigeration trade to recycle the refrigerants to a larger extent. Estimates have been made for three different scenarios for the installed amount of refrigerant in Denmark and for the development of this to 2006. At this time it is estimated that the last CFC 12 plant is taken out of operation. Calculations indicate that if measures are not taken to improve the density of cooling plants, and if the largest possible amount of CFC 12 is not recycled, then a situation of economic demand will soon arise. This will make it difficult to keep the cooling and freezer plants in operation. The refrigerant situation during the phasing out of the CFC 12 refrigerant in Denmark is calculated. (AB).

27351 (NEI-DK–1228) **Refrigeration systems with CFC refrigerants: Report no. 5. Control of consumpiton of refrigerants.** Voers, L. Dansk Teknologisk Inst., Taastrup (Denmark). Energiteknologi. Jan 1993. 50p. (In Danish). Order Number DE93500387. Source: OSTI; NTIS.

In connection with the control of consumption of refrigerants it is important to measure their path from the importer to final tapping as used refrigerants, as well as cleansing/re-cycling or destruction. The use of CFC as a means of heat transmission in closed refrigeration circuits is mainly dealt with. An on-going control of CFC consumption is required, to avoid reckless use, and endeavour to hold consumption low and keep the re-cycling percentage high. The purpose of the project has been to draw up a set of rules to control consumption of CFC refrigerants from the factory or importer to the end-user, as well as from end-user to re-cycling or destruction. The control system is set up in such a way that it is difficult or impossible for a business to buy/use CFC without having the necessary permission. (CFC Permit). This means that businesses which obtain such permits both are given rights, but are also subject to certain obligations in connection with reporting CFC consumption. The control system "KMO Scheme" was started up 15th April 1992 in cooperation between the Danish Energy Agency, CFC wholesale dealers and the authorised refrigerant firms' trade organization. All businesses must in future be approved by the KMO scheme in order to be able to purchase and handle CFC. The committee must evaluate whether the firm in question is capable of handling CFC in a responsible fashion, with regard to the working environment, the external environment and safety. Firms which use CFC must be able to provide documentation for their competence and must be able to substantiate that they have the necessary equipment to enable them to handle both clean and polluted CFC efficiently. (AB).

27352 (NEI-DK–1229) **Refrigeration systems with CFC refrigerants: Report no. 6. Alternative refigerants for cooling and heat pump systems.** Hoegaard Knudsen, H.J.; Martens, P. Dansk Teknologisk Inst., Taastrup (Denmark). Energiteknologi. Jan 1993. 149p. (In Danish). Order Number DE93500389. Source: OSTI; NTIS.

Approximately 100 refrigerants (alternative to chlorofluorocarbons) were investigated - both clean and mixtures. Detailed refrigerant data are included for: R 123, R 134a, R 142b and R 152a as well as ODP and GWP (halogenated hydrocarbons) values for relevant refrigerants. Methods of conversion of existing systems with R-12 to operation with R-22 are described. Efficiency with R22 will, for the same refrigerating capacity, be the same as for R12. An experimental examination of the use of primarily propane and butance as refrigerants, as well as of the danger of explosion when using gas (butane) as refrigerant in small, hermetic refrigeration systems is described in detail. For the first experiment, the refrigerator door was closed. When the explosion occurred, the door was thrown open, and burns would have been likely within a distance of approximately 1.5 m. For the second experiment, the door was closed and sealed with 5 cm wide canvas tape to simulate child proofing. There would have been risk of injuries if someone had been close to the refrigerator because of the speed at which the door opened. Burns would have been likely within a distance of approximately 1.5 - 2.0 m. For the third experiment, the refrigerator door was closed, sealed and equipped with a galvanized steel band. This time the explosion was so violent that the door was torn off and the tape and the steel band were torn apart. There would have been risk of burns within a distance of 2.0 - 2.5 m, as well as serious injuries. (AB) (49 refs.).

27353 (NUREG/GR–0006) **DEPOSITION: Software to calculate particle penetration through aerosol transport systems: Final report.** Anand, N.K. (Texas A and M Univ., College Station, TX (United States). Dept. of Mechanical Engineering); McFarland, A.R.; Wong, F.S.; Kocmoud, C.J. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Regulatory Applications; Texas A and M Univ., College Station, TX (United States). Dept. of Mechanical Engineering. Apr 1993. 36p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Source: OSTI; NTIS; INIS; GPO.

User-friendly software (DEPOSITION 2.0) has been developed which permits characterization of aerosol particle losses in transport systems. Tho sub-models which comprise the DEPOSITION code are presented and the limitations of these sub-models are noted. These sub-models have all been previously published in the peer-reviewed literature. The software can be used to determine the penetration aerosol through existing transport systems; it will provide the optimal tube diameter for a transport system operated at a given flow rate and at a given particle size; it will provide a value for the maximum penetration for a transport system that would connect two points in three-dimensional space; and it will provide tables of data and create output files for parametric studies on the effects of varying particle size, flow rate and tube diameter. Use of this software for specific examples is given herewith in an Appendix. Reference to this software is included in NRC Regulatory Guide 8.25 (1992) where it is considered to be an acceptable method for calculating the penetration of particles through sampling systems.

27354 (NUTEK-FBT–93-7) **Heterogeneous reactions between Fe_3O_4 and flue gas components.** Lindstedt, A. (Chalmers Inst. of Technology and Gothenburg Univ. (Sweden). Dept. of Inorganic Chemistry); Abul Milh, M.; Lindqvist, O. Swedish National Board for Industrial and Technical Development (NUTEK), Stockholm (Sweden). 1993. 21p. (In Swedish). Project NUTEK-276-481. Order Number DE93500726. Source: OSTI; NTIS.

Reactions between Fe_3O_4 (magnetite) or Fe_2O_3 (hematite) with flue gas components like O_2, NO, CO and SO_2 have been studied in a fixed bed reactor. The experimental conditions were chosen to simulate the environment in a fluidized bed reactor for coal combustion. Gases were analysed by mass spectrometry. Reaction temperatures were 600-900 deg C and the concentration of the gases were approximately 1000 ppm. No is reduced with the formation of Fe_2O_3 and N_2 as a result. Magnetite is consumed during the reaction due to oxidation to hematite. NO is reduced to N_2. Magnetite reacts with oxygen and is therefore oxidized more quickly in the presence of O_2. The percentage level of reduction of NO over non-oxidized Fe_3O_4 is independent of the NO concentration in the range 200-5000 ppm. At high temperatures and high concentrations of O_2 a net production of NO of about 1-2% was detected. The production of NO might be catalysed by Fe_2O_3, since a net production of NO was detected in the experiments with SO_2 and NO over Fe_2O_3 when O_2 was present. Comparative investigations of the NO reduction capacity were performed with four different magnetites. The specific surface area of the different magnetites could not be related to the NO reduction capacity. Other properties, for example the character of the surface, seems to be of importance. The oxidation of magnetite proceeds slowly in the presence of CO and the capacity for NO reduction therefore increases. SO_2 is oxidised to SO_3 and is only adsorbed in significant amounts at lower temperatures (600 deg C). (17 refs., 12 figs., 2 tabs.).

27355 (OEFZS–4660) **Decontamination strategies in case of satellite crash.** Mueck, K. (Hauptabteilung Strahlenschutz, Bereich Lebenswissenschaften, Forschungszentrum Seibersdorf GmbH, Seibersdorf (Austria)). Oesterreichisches Forschungszentrum Seibersdorf GmbH (Austria). Dec 1992. [31p.] (In German). Order Number DE93628040. Source: OSTI; NTIS (US Sales Only); INIS.

Provided with ISSN 0253-5270.

In order to ensure an optimum search for radioactive debris after a fallout from a satellite with reactor on board in a densely populated country like Austria, measurements with several detectors and search methods (airborne, vehicle and foot-troop search) were performed. The investigated devices comprised the air reconaissance probe, 3'x3', 5'x6', and 331 NaI-detectors as well as semiconductor detectors. The different search methods and their detection limits as well ws the optimum search approach for each detector are compared. Depending on the search area, requirements for each method are derived which should limit the possible dose to the population according to the maximum values as proposed by ICRP for major radiation accidents. From this a search plan is derived in which a specific search method is recommended for each search area according to its utilization type (fields, forests, traffic areas, suburban areas, playing grounds, camping grounds) which ensures that fragments deposited on this area above a given activity are discovered so that a surpassing of a dose of 1 mSv for members of the public becomes extremly unlikely. (author).

27356 (ORNL/FTR–4453) **Acidification of freshwater ecosystems: Foreign trip report, September 25–October 19, 1992.** Van Miegroet, H. Oak Ridge National Lab., TN (United States). 29 Oct 1992. 24p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93009935. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The traveler was invited to participate in the Dahlem Workshop on Acidification of Freshwater Ecosystems in Berlin, Germany, September 27–October 2, 1992; to present a seminar and discuss issues related to nitrogen cycling in forest ecosystems at the newly established Bayreuth Institute for Terrestrial Ecology (BITOEK) in Bayreuth, Germany, October 5–6,1992; and to present a seminar and discuss issues related to modeling of atmospheric deposition effects on terrestrial and aquatic ecosystems and concerning European Critical Loads activities with research staff at the National Institute of Public Heath and Environmental Protection in Bilthoven (RIVM), The Netherlands; and at the Winand Staring Center for Integrated Land, Soil, and Water Research (Staring Center) in Wageningen, The Netherlands, October 8–9, 1992.

27357 **Cooler and particulate separator for an off-gas stack.** Wright, G.T. To Dept. of Energy. 8 Apr 1991. USA patent application 7-681,292. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93008216. Source: OSTI; NTIS; GPO Dep.

This report describes an off-gas stack for a melter, furnace or reaction vessel comprising an air conduit leading to two sets of holes, one set injecting air into the off-gas stack near the melter plenum and the second set injecting air downstream of the first set. The first set injects air at a compound angle, having both downward and tangential components, to create a reverse vortex flow, counter to the direction of flow of gas through the stack and also along the periphery of the stack interior surface. Air from the first set of holes prevents recirculation zones from forming and the attendant accumulation of particulate deposits on the wall of the stack and will also return to the plenum any particulate swept up in the gas entering the stack. The second set of holes injects air in the same direction as the gas in the stack to compensate for the pressure drop and to prevent the concentration of condensate in the stack. A set of sprayers, receiving water from a second conduit, is located downstream of the second set of holes and sprays water into the gas to further cool it.

27358 (PNL–8550) **A study of the compliance of the Gaseous Effluent Sampling and Monitoring System with interim criteria: 296-B-10 stack, Waste Encapsulation and Storage Facility.** Schwendiman, L.C.; Glissmeyer, J.A. Pacific Northwest Lab., Richland, WA (United States). Feb 1976. 57p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93009496. Source: OSTI; NTIS; GPO Dep.

A study is underway by Battelle-Northwest to evaluate existing gaseous effluent sampling systems in ARHCO process buildings, including the 225-B Waste Encapsulation and Storage Facility (WESF). An interim report concerning the WESF effluent sampling systems was issued in March of 1975. The objective of this report is to evaluate the compliance of the WESF exhaust stack air sampler and monitor with the interim criteria established by ARHCO, and to recommend corrective actions. This evaluation is based on the previous analysis of the sample collection device contained in BNWL-B-408 and recently gathered information on the sample monitoring instrumentation and sample collection device.

27359 (PNL–8551) **Preliminary evaluation of the gaseous effluent sampling systems at the 291-A-1, 296-A-1, and 296-A-2 stacks:-Purex Plant.** Glissmeyer, J.A.; Schwendiman, L.C. Pacific Northwest Lab., Richland, WA (United States). Jun 1976. 93p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93009495. Source: OSTI; NTIS; GPO Dep.

The particulate effluent sampling and monitoring systems at three Purex Plant Stacks, 291-A-1, 296-A-1, 296-A-2, are the subjects of this evaluation for compliance with Atlantic Richfield Hanford Company's Interim Criteria for such systems (Appendix A). This evaluation is part of a larger study, sponsored by ARHCO and conducted by Battelle-Northwest, of gaseous effluent sampling systems in ARHCO operated facilities. The conclusions and recommendations of this report are considered preliminary because the conclusions have not been experimentally verified and because of the many uncertainties about system characteristics.

27360 (PNL–8552) **Preliminary evaluation of the gaseous effluent sampling system of the 296-P-3 portable exhauster, BY-Tank Farm.** Glissmeyer, J.A.; Schwendiman, L.C. Pacific Northwest Lab., Richland, WA (United States). Mar 1977. 33p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93009499. Source: OSTI; NTIS; GPO Dep.

Cover sheet for a Hanford Historical Document released for public availability.

This evaluation of the 296-P-3 stack sampling system is part of a larger study, sponsored by ARHCO and conducted by Battelle-Northwest, of effluent airborne particulate sampling systems in ARHCO facilities. The 296-P-3 stack is similar to many portable exhauster units deployed in the tank farms. The objectives of this study are: Evaluate the compliance of the particulate sampling system with ARHCO's Interim Criteria for such systems by using sampling theory; make recommendations for corrective action which will lead to a particulate sampling system in compliance with the Interim Criteria; and the conclusions and recommendations are to be generally applicable to sampling systems of the same type as at the 296-P-3 stack. This study is considered preliminary because no experiments have been conducted to verify the sampling system's performance. The following report includes a brief summary, a detailed description and evaluation of the sampling system, conclusions and recommendations for corrective action. The appendices contain a copy of the Interim Criteria, the ARHCO Emergency Procedure regarding radioactive gaseous discharges from this facility and calculations.

27361 (PNL–8553) **Preliminary evaluation of the gaseous effluent sampling system at the 296-S-18 stack, 242-S evaporator.** Glissmeyer, J.A.; Schwendiman, L.C. Pacific Northwest Lab., Richland, WA (United States). Apr 1977. 39p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93009500. Source: OSTI; NTIS; GPO Dep.

This evaluation of the 296-S-18 stack sampling system is part of a larger study, sponsored by ARHCO and conducted by Battelle-Northwest, of gaseous effluent sampling systems in ARHCO facilities. It is the fourth and last in a series of evaluations of tank farm stack sampling systems. The objectives of this study are: Evaluate the compliance of the existing effluent particulate sampling system with ARHCO's Interim Criteria for such systems by using sampling theory and radioactivity counting statistics; and make recommendations for corrective action which will lead to a particulate sampling system in compliance with the Interim Criteria. This study is considered preliminary because no experiments have been conducted to verify the sampling system's performance. The following report includes a brief summary, a detailed description and evaluation of the sampling system, conclusions about

satisfactory or deficient areas of the sampling system and recommendations for corrective action. The appendices contain a copy of the Interim Criteria and the applicable ARHCO Emergency Procedure for radioactive gaseous discharges.

27362 (PNL–8554) **Preliminary evaluation of the gaseous effluent sampling system at the 296-A-17 stack: A, AX, AY, tank farm.** Glissmeyer, J.A.; Schwendiman, L.C. Pacific Northwest Lab., Richland, WA (United States). Dec 1976. 39p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93009497. Source: OSTI; NTIS; GPO Dep.

Cover sheet for a Hanford Historical Document released for public availability.

This evaluation of the 296-A-17 stack sampling system is part of a larger study, sponsored by ARHCO and conducted by Battelle-Northwest, of gaseous effluent sampling systems in ARHCO facilities. The objectives of this study are: Evaluate the compliance of the existing effluent particulate sampling system with ARHCO's Interim Criteria for such systems by using sampling theory and radioactivity counting statistics; and make recommendations for corrective action which will lead to a particulate sampling system in compliance with the Interim Criteria. This study is considered preliminary because no experiments have been conducted to verify the sampling system's performance. The following report includes a brief summary, a detailed description and evaluation of the sampling system, conclusions about satisfactory or deficient areas of the sampling system and recommendations for corrective action. The appendices contain a copy of the Interim Criteria, flowmeter correction calculations and applicable ARHCO Emergency Procedures.

27363 (PNL–8555) **Preliminary evaluation of the gaseous effluent sampling system at the 296-A-12 stack, 244-AR Vault Vessel Vent.** Glissmeyer, J.A.; Schwendiman, L.C. Pacific Northwest Lab., Richland, WA (United States). Feb 1977. 35p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93009498. Source: OSTI; NTIS; GPO Dep.

Cover sheet for a Hanford Historical Document released for public availability.

This evaluation of the 296-A-12 stack sampling system is part of a larger study, sponsored by ARCHO and conducted by Battelle-Northwest, of gaseous effluent sampling systems in ARHCO facilities. The objectives of this study are: Evaluate the compliance of the existing effluent particulate sampling system with ARHCO's Interim Criteria for such systems by using sampling theory and radioactivity counting statistics and make recommendations for corrective action which will lead to a particulate sampling system in compliance with the Interim Criteria. This study is considered preliminary because no experiments have been conducted to verify the sampling system's performance. The following report includes a brief summary, a detailed description and evaluation of the sampling system, conclusions about satisfactory or deficient areas of the sampling system and recommendations for corrective action. The appendices contain a copy of the Interim Criteria and the applicable ARHCO Emergency Procedure for radioactive gaseous discharges.

27364 (PNL-SA–22080) **Statement on global climate change before the Subcommittee on Energy and Power, United States House of Representatives.** Edmonds, J.A. Pacific Northwest Lab., Richland, WA (United States). Apr 1993. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93013163. Source: OSTI; NTIS; INIS; GPO Dep.

Greenhouse gases are gases which are effectively transparent to incoming sunlight but absorb infrared radiation escaping to space and thereby warm the surface of the Earth. Human activities result in the release of greenhouse and related gases in such quantities that they are changing the composition of the atmosphere. Greenhouse and related gases which human activities release include carbon dioxide (CO_2), methane (CH_4) carbon monoxide (CO), nitrous oxide (N_2O), nitrogen oxides (NO_x), chlorofluorocarbons (CFCs) and sulphur dioxide (SO_2). The emission and effects of these gases are detailed in this report.

27365 (PNL-SA–22390) **Global change research: Science and policy.** Rayner, S. Pacific Northwest Lab., Richland, WA (United States). May 1993. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-9305219–1: Global change research: science and policy meeting, Washington, DC (United States), 17 May 1993). Order Number DE93015675. Source: OSTI; NTIS; INIS; GPO Dep.

This report characterizes certain aspects of the Global Change Research Program of the US Government, and its relevance to the short and medium term needs of policy makers in the public and private sectors. It addresses some of the difficulties inherent in the science and policy interface on the issues of global change. Finally, this report offers some proposals for improving the science for policy process in the context of global environmental change.

27366 (PNWD–2033-HEDR-Vol.2) **Iodine-131 releases from the Hanford Site, 1944–1947: Volume 2, Data: Hanford Environmental Dose Reconstruction Project.** Heeb, C.M. Pacific Northwest Lab., Richland, WA (United States). Mar 1993. 229p. Sponsored by Department of Health and Human Services, Washington, DC (United States). DOE Contract AC06-76RL01830. Contract 200-92-053(CDC)/18620(BNW). Order Number DE93011908. Source: OSTI; NTIS; INIS; GPO Dep.

Detailed results of the Hanford Environmental Dose Reconstruction project (HEDR) iodine-131 release reconstruction are presented in this volume. Included are daily data on B, D, and F Plant, reactor operations from the P-Department Daily Reports (General Electric Company 1947). Tables of B and T Plant material processed from the three principal sources on separations plant operations: The Jaech report (Jaech undated), the 200 Area Report (Acken and Bird 1945; Bird and Donihee 1945), and the Metal History Reports (General Electric Company 1946). A transcription of the Jaech report is also provided because it is computer-generated and is not readily readable in its original format. The iodine-131 release data are from the STRM model. Cut-by-cut release estimates are provided, along with daily, monthly, and yearly summations. These summations are based on the hourly release estimates. The hourly data are contained in a 28 megabyte electronic file. Interested individuals may request a copy.

27367 (SAND–93-1031C) **Environmentally conscious manufacturing life cycle analysis.** Watkins, R.D.; Baca, A. Sandia National Labs., Albuquerque, NM (United States). [1993]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9305187–3: Ideas in science and electronics, Albuquerque, NM (United States), 11 May 1993). Order Number DE93014992. Source: OSTI; NTIS; INIS; GPO Dep.

Sandia National Laboratories and the Allied Signal-Kansas City Plant (AS-KCP) are engaged in a program called the Integrated Manufacturing and Design Initiative, or IMDI. The focus of IMDI is "to develop and implement concurrent engineering processes for the realization of weapon components." An explicit part of each of the activities within IMDI is an increased concern for environmental impacts associated with design, and a desire to minimize those impacts through the implementation of Environmentally Conscious Manufacturing, or ECM. These same concerns and desires are shared within the Department of Energy's Manufacturing Complex, and are gaining strong support throughout US industrial sectors as well. Therefore, the development and application of an environmental life cycle analysis framework, the thrust of this specific effort, is most consistent not only with the overall objectives of IMDI, but with those of DOE and private industry.

27368 (SCPRI-RM–1-1993) **Monthly results of measurements; January 1993.** Service Central de Protection contre les Rayonnements Ionisants, 78 - Le Vesinet (France). 1993. [41p.] (In French). Order Number DE93630787. Source: OSTI; NTIS (US Sales Only); INIS.

This report of the SCPRI exposes the main results concerning the routine monitoring of environmental radioactivity in France: atmospheric dusts, rainwater, surface water, underground water, sewage water, drinking water, food chain (milk, vegetables, fishes), sea water around nuclear sites and other sites. The activities of various radioisotopes are presented in tables.

27369 (TVA/NFERC–92/6) **Environmental awareness.** National Fertilizer and Environmental Research Center, Muscle Shoals, AL (United States). [1992]. 38p. Sponsored by Tennessee Valley Authority, Knoxville, TN (United States). (TVA-Bull–Y-228). Order Number DE93014192. Source: OSTI; NTIS.

This brochure is intended to provide guidance on environmental regulations to National Fertilizer and Environmental Research Center (NFERC) employees. Topics covered include: handling of hazardous materials, disposal of hazardous wastes, spill prevention and remediation, pcb contamination, pesticide use, asbestos remediation, solid waste disposal, and environmental laws. Safety aspects are emphasized.

27370 (UCRL-CR–109856) **Modeling of aqueous chemistry in cloud droplets.** Kreidenweis, S.M. (San Jose State Univ., CA (US)). Lawrence Livermore National Lab., CA (United States). Feb 1992. 55p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93015010. Source: OSTI; NTIS; GPO Dep.

The code AQCHEM.FOR, a listing of which is attached, has been prepared as a tool for the investigation of chemical reactions occurring in cloud drops. The present application is to the formation of sulfate (S(VI)) via reaction of S(IV) species with ozone and hydrogen peroxide. However, the model is constructed in a general format that allows introduction of other species and reactions easily. The model also stimulates mass transfer between the liquid and gas phases, so that the assumption of equilibrium between these phases need not be invoked. Representative model simulations are presented and show good agreement with results published from similar codes. The model will be used to develop parameterizations of aqueous sulfate production rates for inclusion in a global model of the sulfur cycle.

27371 (UCRL-ID–112181) **The "footprint" area influencing a high-volume air sampler.** Shinn, J.; Gouveia, F. Lawrence Livermore National Lab., CA (United States). Oct 1992. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93013947. Source: OSTI; NTIS; GPO Dep.

A recent question posed by air sampling analysts is how to calculate the source area that contributes to the collection of material by a high-volume (HV) air sampler. In micrometeorology studies theoretical and numerical approaches have been used to determine the "footprint" of an atmospheric flux from the ground that influences a sensor at any given height. Over the course of a few days or more, the influence of atmospheric stability on a high volume air sampler run can be neglected. For surfaces that have dense vegetative cover, the boundary layer is displaced upward by the vegetation height and the roughness is proportional to the vegetation height. It can be concluded that for typical surface conditions, the HV air sampler is 90% influenced by material flux from the surface less than 145–175 m upwind. For rougher surfaces, the upwind bounded distances are shorter. There may be some very specialized cases (e.g., empty parking lots) where the upwind bounded distances are much greater.

27372 (UCRL-ID–112984) **Preliminary meteorological results for 1992 West Coast Scotland Experiment.** Robey, H.F. Lawrence Livermore National Lab., CA (United States). 4 Jan 1993. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93014677. Source: OSTI; NTIS; GPO Dep.

This memo documents preliminary meteorological results from the 1992 West Coast Scotland Experiment, a joint US/UK radar ocean imaging experiment. Measurements of wind speed and direction are reported for both phases of the experiment covering the periods from June 7–13 and from June 19–25. The measurements were obtained using a Campbell Scientific CR10 Datalogger and R. M. Young model 03001-5 anemometer and wind wane. The anemometer has a resolution of 0.1 m/s and the wind vane 1°, but motion of the ship platform reduces the precision of the direction measurements to ±10°. Data were downloaded to an IBM PC-AT for final storage and analysis. The anemometer was mounted at a height of 10 meters above the mean water surface on top of a mast located at the bow of the Royal Marine Auxiliary Service (R.M.A.S.) tug, "Cairn". The Cairn was moored at the center of the experiment site at 57°7.13755' N, 5°44.88521' W in the Sound of Sleat, nominally 200 meters from the ship track. Wind velocity and direction were recorded at a sample rate of 0.2 Hz, and the averaged value was output every 10 minutes from approximately 2 hours before the start of the first run to 2 hours after the end of the last run. Data are plotted in the following pages in 2 formats for a quick visual summary of the daily wind conditions. The top plot gives wind velocity (m/s) and direction (degrees true) vs time given in minutes relative to the start of the first run which is designated as "T". The lower plot gives a polar plot of the same data with velocity on the radial axis and direction on the azimuthal axis. The final two plots give a summary of the wind speed vs direction for phase 1 (June 7–13) and phase 2 (June 19–25).

27373 (UCRL-JC–110318) **Stratospheric ozone conservation by electron attachment to chlorine atoms.** Tsang, K.T. (Science Applications International Corp., McLean, VA (United States)); Ho, D.D.M.; Wong, A.Y.; Siverson, R.J. Lawrence Livermore National Lab., CA (United States). 23 Apr 1992. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-900922–1: Workshop on removal of particles from upper atmosphere by means of electromagnetic and plasma waves: active global experiments, Varenna (Italy), 5-12 Sep 1990). Order Number DE93009242. Source: OSTI; NTIS; GPO Dep.

The feasibility of recent proposal by Wong to stop stratospheric ozone destruction by converting neutral chlorine atoms into negative ions is investigated with a detailed numerical chemistry model. Two cases, which lead to estimates of the upper and lower bounds of the conversion efficiency, are studied. In the first case, electrons are introduced to a steady state of atmospheric chemical equilibrium. Up to 90% of the electrons are eventually attached to the chlorine atoms to form chlorine ions or water clusters of chlorine ions ($Cl^- \cdot H_2O$). In the second case, a plasma of electrons and ions is produced by intense microwave ionization of the background neutral nitrogen and oxygen molecules. Because of the large number of electrons lost in recombinations, roughly 1% of the electrons are attached to the chlorine atoms. However, since the conventional recombination rates we used in the modeling are much higher than that implied by recent experiments, this result is an underestimate of the actual conversion efficiency.

27374 (UCRL-JC–110365) **Modeling of air currents in the Gulf Region.** Sullivan, T.J.; Ellis, J.S.; Foster, C.S.; Foster, K.T.; Baskett, R.L.; Nasstrom, J.S.; Schalk, W.W. Lawrence Livermore National Lab., CA (United States). 14 Apr 1992. 32p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9204242–1: Environmental dimensions of the Gulf: policy and institutional perspectives workshop, Al-Ain (United Arab Emirates), 19-22 Apr 1992). Order Number DE93010509. Source: OSTI; NTIS; INIS; GPO Dep.

The Atmospheric Release Advisory Capability modeled the wind flow in the Gulf Region in order to make projections of the Kuwait oil fires pollution dispersion. Extensive meteorological models incorporating explicit terrain influences to the flow fields were routinely employed through a six month international assessment support effort organized by the World Meteorological Organization and US scientific research agencies. Results show generally close agreement with visible imagery of the smoke plumes as detected by meteorological satellites. However, there are some examples of significant disagreement or failure of the meteorological models. These failures are most likely directly linked to missing or unavailable weather observations.

27375 (UCRL-JC–110401) **Risk assessment of DOE defense program packages in a beyond 10 CFR 71.73 transportation accident environment.** Sandquist, G.M. (Utah Univ., Salt Lake City, UT (United States). Dept. of Nuclear Engineering); Bennion, J.S.; Moore, J.E.; Kimura, C.Y. Lawrence Livermore National Lab., CA (United States). 15 Oct 1992. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9301102–4: American Nuclear Society (ANS) meeting, Clearwater, FL (United States), 27 Jan 1993). Order Number DE93012573. Source: OSTI; NTIS; INIS; GPO Dep.

A comprehensive program is being conducted by the DOE to determine the risks related to the domestic transportation of radioactive and hazardous materials associated with nuclear weapons. The program is designed to identify, quantify and manage potential risks to public health and safety including potential radiological and toxicological health consequences which may exceed the 10 CFR 71.73 transportation accident environment A major objective of this program being performed by the Lawrence Livermore National Laboratory (LLNL) and the University of Utah is to provide the DOE with the methodology and bases for evaluating highway transportation activities by DOE contractors. This paper describes the approach and the HITRA model which is based upon probabilistic risk assessment (PRA) methodology and route specific data associated with the proposed transportation activity. The model is capable of providing detailed location and time specific data for assessing projected risks to public health and safety from DOE defense program materials shipments.

27376 (UCRL-JC–111416) **A real-time emergency response workstation using a 3-D numerical model initialized with sodar.** Lawver, B.S. (Lawrence Livermore National Lab., CA (US)); Sullivan, T.J.; Baskett, R.L. Lawrence Livermore National Lab., CA (United States). 28 Jan 1993. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-930140–4: International specialty conference: the role of meteorology in managing the environment in the 1990s, Scottsdale, AZ (United States), 26-28 Jan 1993). Order Number DE93016534. Source: OSTI; NTIS; GPO Dep.

Many emergency response dispersion modeling systems provide simple Gaussian models driven by single meteorological tower inputs to estimate the downwind consequences from accidental spills or stack releases. Complex meteorological or terrain settings demand more sophisticated resolution of the three-dimensional structure of the atmosphere to reliably calculate plume dispersion. Mountain valleys and sea breeze flows are two common examples of such settings. To address these complexities, the authors have implemented the three-dimensional diagnostic MATHEW mass-adjusted wind field and ADPIC particle-in-cell dispersion models on a workstation for use in real-time emergency response modeling. MATHEW/ADPIC have shown their utility in a variety of complex settings over the last 15 years within the Department of Energy's Atmospheric Release Advisory Capability (ARAC) project. The models are initialized using an array of surface wind measurements from meteorological towers coupled with vertical profiles from an acoustic sounder (sodar). The workstation automatically acquires the meteorological data every 15 minutes. A source term is generated using either defaults or a real-time stack monitor. Model outputs include contoured isopleths displayed on site geography or plume densities shown over 3-D color shaded terrain. The models are automatically updated every 15 minutes to provide the emergency response manager with a continuous display of potentially hazardous ground-level conditions if an actual release were to occur. Model run time is typically less than 2 minutes on 6 megaflop (~30 MIPS) workstations. Data acquisition, limited by dial-up modem communications, requires 3 to 5 minutes.

27377 (UCRL-JC–113583) **Factors influencing the parameterization of anvil clouds within GCMs.** Leone, J.M. Jr.; Chin, Hung-Neng. Lawrence Livermore National Lab., CA (United States). Mar 1993. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9303122–5: 3. ARM science team meeting, Norman, OK (United States), 1-5 Mar 1993). Order Number DE93017182. Source: OSTI; NTIS; INIS; GPO Dep.

The overall goal of this project is to improve the representation of clouds and their effects within global climate models (GCMs). The authors have concentrated on a small portion of the overall goal, the evolution of convectively generated cirrus clouds and their effects on the large-scale environment. Because of the large range of time and length scales involved they have been using a multi-scale attack. For the early time generation and development of the cirrus anvil they are using a cloud-scale model with horizontal resolution of 1–2 kilometers; while for the larger scale transport by the larger scale flow they are using a mesoscale model with a horizontal resolution of 20–60 kilometers. The eventual goal is to use the information obtained from these simulations together with available observations to derive improved cloud parameterizations for use in GCMs. This paper presents results from their cloud-scale studies and describes a new tool, a cirrus generator, that they have developed to aid in their mesoscale studies.

27378 (WINCO–1128) **ICCP Environmental Monitoring Report CY-1992.** Neff, J.K. Westinghouse Idaho Nuclear Co., Inc., Idaho Falls, ID (United States). Jul 1993. 47p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-84ID12435. Order Number DE93015610. Source: OSTI; NTIS; INIS; GPO Dep.

Summarized in this report are the data collected through Environmental Monitoring programs conducted at the Idaho Chemical Processing Plant (ICPP) by the Environmental Safety & Health (ES&H) Department. This report is published in response to DOE Order 5400.1. This report covers the period from December 21, 1991 through December 20, 1992 and details airborne and liquid effluents from the Chemical Processing Plant.

27379 (WSRC-TR–93-215) **Assessment of radiocarbon in the Savannah River Site Environment.** Carlton, W.H.; Evans, A.G.; Murphy, C.E. Jr.; Tuck, D.M. Westinghouse Savannah River Co., Aiken, SC (United States). Mar 1993. 46p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93014759. Source: OSTI; NTIS; INIS; GPO Dep.

This report is a radiological assessment of ^{14}C releases from the Savannah River Site. During the operation of five production reactors ^{14}C has been produced at SRS. Approximately 3000 curies have been released to the atmosphere but there are no recorded releases to surface waters. Once released, the ^{14}C joins the carbon cycle and a portion enters the food chain. The overall radiological impact of SRS releases on the offsite maximum individual can be characterized by a dose of 1.1 mrem, compared with a dose of 12,960 mrem from non-SRS sources during the same period of time. Releases of ^{14}C have resulted in a negligible risk to the environment and the population it supports.

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Refer also to citation(s) 25606, 25607, 25681, 25686, 25687, 25696, 25731, 25737, 25738, 25752, 25755, 25758, 25764, 25787, 25801, 25804, 25814, 25836, 25837, 25838, 25840, 25844, 25856, 25862, 25864, 25865, 25870, 25872, 25873, 25874, 25877, 25882, 25885, 25919, 25977, 25982, 25983, 25985, 25986, 25987, 25988, 25990, 26421, 26439, 26475, 26528, 26541, 26712, 26720, 26721, 26722, 26850, 26898, 27248, 27270, 27300, 27315, 27346, 27355, 27356, 27367, 27368, 27369, 27375, 27378, 27379, 27475, 27480, 27487, 27489, 27492, 27493, 27502, 27506, 27514, 27653, 27666, 27910, 28143

27380 (ANL/EAIS–8) **Data collection handbook to support modeling the impacts of radioactive material in soil.** Yu, C. (Argonne National Lab., IL (United States). Environmental Assessment and Information Sciences Div.); Cheng, J.J.; Jones, L.G.; Wang, Y.Y.; Faillace, E.; Loureiro, C.; Chia, Y.P. Argonne National Lab., IL (United States). Environmental Assessment and Information Sciences Div. Apr 1993. 152p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93015606. Source: OSTI; NTIS; INIS; GPO Dep.

A pathway analysis computer code called RESRAD has been developed for implementing US Department of Energy Residual Radioactive Material Guidelines. Hydrogeological, meteorological, geochemical, geometrical (size, area, depth), and material-related (soil, concrete) parameters are used in the RESRAD code. This handbook discusses parameter definitions, typical ranges, variations, measurement methodologies, and input screen locations. Although this handbook was developed primarily to support the application of RESRAD, the discussions and values are valid for other model applications.

27381 (ANL/ER/CP–79580) **A technical approach to groundwater contamination problems.** Burton, J.C.; Leser, C.; Rose, C.M. Argonne National Lab., IL (United States). [1993]. 7p.

Sponsored by USDOE, Washington, DC (United States); Department of Agriculture, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9306159–2: 1993 Society of Women Engineers (SWE) conference, Chicago, IL (United States), 21-27 Jun 1993). Order Number DE93014876. Source: OSTI; NTIS; INIS; GPO Dep.

Argonne National Laboratory has been performing technical investigations at sites in Nebraska and Kansas that have identified groundwater contamination by carbon tetrachloride. This comprehensive program will ultimately provide the affected communities with safe drinking water. The first step in the program is to evaluate the available data and identify sites that will require an Alternate Water Supply Study (AWSS). The objective of the AWSS is to identify options for providing a safe drinking water supply to all users, in compliance with the Safe Drinking Water Act. The AWSS consists of an engineering and cost evaluation followed by implementation of the selected alternative. For sites with contamination less than a specific concentration, the AWSS is regarded as a satisfactory long- term solution, and no further action is taken. For those sites with concentrations above that specific limit, the AWSS implementation is regarded as only a stopgap measure, and the site is selected for additional remedial action. The first step of the remedial action is an Expedited Site Characterization (ESC). The ESC was developed at Argonne to decrease the cost and time of the remedial investigation and feasibility study while producing a high-quality technical investigation. The ESC is designed to characterize the contaminant plume configuration and movement, which requires an understanding of the geological and hydrogeologic controls on groundwater movement as well as the nature and extent of any remaining carbon tetrachloride source in the soils. The ESC program uses a multidisciplinary technical approach that incorporates geology, geochemistry, geohydrology, and geophysics. Field activities include sampling, chemical analysis, and borehole and surface geophysical surveys.

27382 (ANL/ES/CP–77816) **Gas-rich sediment and coastal wetland loss in Louisiana.** Thompson, M.D.; McGinnis, L.D.; Wilkey, P.L.; Miller, S.F. Argonne National Lab., IL (United States). [1993]. 14p. Sponsored by USDOE, Washington, DC (United States); Gas Research Inst., Chicago, IL (United States). DOE Contract W-31109-ENG-38. Contract 5088-252-1770. (CONF-9304109–2: SAGEEP '93: symposium on the application of geophysics to environmental and engineering problems, San Diego, CA (United States), 18-21 Apr 1993). Order Number DE93009963. Source: OSTI; NTIS; GPO Dep.

High rates of wetland loss in southern Louisiana provide the impetus for examining the role that trapped, biogenic gases play in regulating subsidence of coastal areas. A significant cause for wetland loss in this region is relative sea-level rise produced by sediment-volume reduction. Dewatering, grain reorientation and packing, and oxidation of organic-rich sediments are thought to be the main processes for volume loss. It is argued that natural and anthropogenic causes for sediment degasification play a critical role in sediment-volume reduction. Compressional wave velocities were measured at 34 sites in both the abandoned (Holocene) and modern parts of the Mssissippi Delta. A low-frequency source (<200 Hz) was used to maximize sound-wave dispersion caused by interstitial gas bubbles. Compressional wave velocities measured at low frequencies relative to the gas-bubble resonant-frequency undergo maximum change from the velocity for a gas-free sediment.

27383 (ARL-TR–086) **Properties of plutonium-contaminated particles resulting from British Vixen B trials at Maralinga.** Burns, P.A. (Australian Radiation Lab., Melbourne, VIC (Australia)); Cooper, M.B.; Williams, G.A.; Johnston, P.N. Australian Radiation Lab., Melbourne, VIC (Australia). Dec 1990. [23p.] Order Number DE93630629. Source: OSTI; NTIS (US Sales Only); INIS.

Meteorological data and characteristics of active particles from Maralinga are presented in Appendixes.

Since 1984 a number of studies have been performed to investigate residual contamination at the former atomic weapons test site at Maralinga in South Australia, and to aid in the rehabilitation of the area. The largest site of plutonium contamination at Maralinga results from twelve Vixen B trials conduced at Taranaki in 1960, 1961 and 1963. Plutonium was dispersed along four major plumes from these trials. Measurements of the ratios of activities of ^{239}Pu and ^{240}Pu to ^{241}Am are presented for the plumes. These are identified with individual trials where possible. Some measurements have also been made of ^{235}U activities. An examination of meteorological and health physics survey data suggests that the most extensive part of the north-west plume results from a single trial, viz. Vixen B2 round 5 of 1961. It appears that the level of contamination in this plume was augmented by rainout of material, and the extent of the plume was enhanced by the considerable wind speed at the time. Results of proton-induced X-ray emission spectroscopy (PIXE), which provides elemental content and maps of the distribution of elements on the surface of some of the active particles, are presented, together with some other physical characteristics of the particles, in the expectation that these will aid in hazard assessment and with the development of techniques to rehabilitate the Taranaki site at Maralinga. 17 refs., 4 tabs., 1 fig.

27384 (BNL–70222) **[Participation in United Nations environmental projects]: Foreign trip report, September 9–14, 1992.** Hendrey, G.R. Brookhaven National Lab., Upton, NY (United States). 20 Sep 1992. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. Order Number DE93012357. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Traveler was invited to participate in a scientific review of United Nations Environmental Programme (UNEP) Project Number FP/6108-88-01(2855), titled Environmental Change and the Productivity of Tropical Grasslands running from 1989 through 1992. Tropical grasslands constitute one of the world's largest and most productive ecosystems and sustain populations of millions of people in less developed nations on five of the seven continents. Anticipated changes in global climate have stimulated interest in developing a better understanding of these ecosystems in order to plan for rational management. in particular, increasing atmospheric CO2 and temperature may alter no only rates of photosynthesis, plant growth and plant community dynamics, but also the efficiency of water use, and availability of ground water. This UNEP project addresses such issues at five intensive research sites in Brazil, China, Kenya, Mexico and Thailand emphasizing primary productivity and photosynthesis, with special-focus on carbon cycling, remote sensing and responses to elevated CO2. The project has completed five of seven of the tasks specified in the research plan. Of greatest interest is the development of intensive research sites at the five locales, together with education of the scientific teams making up the core groups at these sites; and successful development and completion of intensive training courses for the measurement of plant production processes in the field.

27385 (CONF-9210354–1) **On the potential for a CO_2 fertilization effect in forest trees: An assessment of 58 controlled-exposure studies and estimates of the biotic growth factor.** Wullschleger, S.D.; Post, W.M.; King, A.W. Oak Ridge National Lab., TN (United States). [1992]. 65p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From IPCC international workshop on biotic feedbacks in the global climate system; Woods Hole, MA (United States); 25-29 Oct 1992. Order Number DE93013530. Source: OSTI; NTIS; INIS; GPO Dep.

Characterizing the response of terrestrial ecosystems to increasing concentrations of atmospheric CO_2 and estimating their biological capacity to either moderate or accelerate predicted changes in the earth's climate, continues to present a formidable challenge to experimentalist and modelers alike. Nevertheless, it is generally recognized that the carbon dynamics of terrestrial vegetation represent an important biospheric feedback to increasing CO_2 concentrations, and hence to global warming, and as such there exists little debate that ecosystems occupy a.potentially pivotal role in determining both the direction and rate of future changes in atmospheric CO_2 concentration. What is currently the subject of much debate, however, is whether terrestrial ecosystems will contribute to global warming by releasing additional CO_2 the atmosphere as a result of increasing respiration and/or decomposition in a warming climate, or whether they will instead sequester additional carbon in response to the enhancing effects of atmospheric CO_2 on plant growth. This latter response, the so-called CO_2 fertilization effect, has been hypothesized as an important

negative feedback to global warming, offering the potential to constrain future increases in atmospheric CO_2 concentration, and has often been invoked to either partially or wholly account for the estimated 1.6 Gt C/year imbalance or "missing sink" in calculations of the global carbon budget.

27386 (CONF-930165–3) **Risk implications of approaches to setting soil remediation goals.** Labieniec, P.A. (Carnegie Mellon Univ., Pittsburgh, PA (US). Dept. of Civil Engineering); Dzombak, D.A.; Siegrist, R.L. Oak Ridge National Lab., TN (United States). [1993]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Water Federation Environment specialty conference on how clean is clean; Washington, DC (United States); 10-13 Jan 1993. Order Number DE93015185. Source: OSTI; NTIS; GPO Dep.

A framework has been developed to evaluate and compare the carcinogenic risk implications of two approaches to establishing soil remediation goals at hazardous waste contaminated sites. The approaches considered are (1) site-specific risk assessment to achieve a specified level of carcinogenic risk and (2) the use of uniform, concentration-based soil quality guidelines. Uncertainty in site-specific risk assessments and variability in site conditions when a uniform approach is used are taken into account. For each approach, cumulative distribution functions representing the regional variability in risk across sites are developed using a soil risk model. The two approaches are then compared based on these distributions. This paper describes the evaluation framework and presents some preliminary results of ongoing research to apply the framework to sites contaminated with trichloroethylene (TCE). Preliminary work in applying the framework to sites contaminated with polychlorinated biphenyls (PCBs) is also described.

27387 (CONF-930483–10) **A life-cycle model approach to multimedia waste reduction measuring performance for environmental cleanup projects.** Phifer, B.E. Jr. (Martin Marietta Energy Systems, Inc., Oak Ridge, TN (US)); George, S.M. Martin Marietta Energy Systems, Inc., Oak Ridge, TN (United States). [1993]. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 9. waste minimization and pollution prevention conference; San Francisco, CA (United States); 13-15 Apr 1993. Order Number DE93016234. Source: OSTI; NTIS; INIS; GPO Dep.

The Martin Marietta Energy Systems, Inc. (Energy Systems), Environmental Restoration (ER) Program adopted a Pollution Prevention Program in March 1991. The program's mission is to minimize waste and prevent pollution in remedial investigations (RIs), feasibility studies, decontamination and decommissioning, and surveillance and maintenance site program activities. Mission success will result in volume and/or toxicity reduction of generated waste. The ER Program waste generation rates are projected to steadily increase through the year 2005 for all waste categories. Standard production units utilized to measure waste minimization apply to production/manufacturing facilities. Since ER inherited contaminated waste from previous production processes, no historical production data can be applied. Therefore, a more accurate measure for pollution prevention was identified as a need for the ER Program. The Energy Systems ER Program adopted a life-cycle model approach and implemented the concept of numerically scoring their waste generators to measure the effectiveness of pollution prevention/waste minimization programs and elected to develop a numerical scoring system (NSS) to accomplish these measurements. The prototype NSS, a computerized, user-friendly information management database system, was designed to be utilized in each phase of the ER Program. The NSS was designed to measure a generator's success in incorporating pollution prevention in their work plans and reducing investigation-derived waste (IDW) during RIs. Energy Systems is producing a fully developed NSS and actually scoring the generators of IDW at six ER Program sites. Once RI waste generators are scored utilizing the NSS, the numerical scores are distributed into six performance categories: training, self-assessment, field implementation, documentation, technology transfer, and planning.

27388 (CONF-930570–2) **The application of GIS and remote sensing technologies for site characterization and environmental assessment.** Durfee, R.C.; McCord, R.A.; Dobson, J.E. Oak Ridge National Lab., TN (United States). [1993]. 45p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 2. annual Federal environmental restoration conference and exhibition; Washington, DC (United States); 25-27 May 1993. Order Number DE93015435. Source: OSTI; NTIS; INIS; GPO Dep.

Environmental cleanup and restoration of hazardous waste sites are major activities at federal facilities around the US. Geographic information systems (GIS) and remote sensing technologies are very useful computer tools to aid in site characterization, monitoring, assessment, and remediation efforts. Results from applying three technologies are presented to demonstrate examples of site characterization and environmental assessment for a federal facility. The first technology involves the development and use of GIS within the comprehensive Oak Ridge Environmental Information System (OREIS) to integrate facility data, terrain models, aerial and satellite imagery, demographics, waste area information, and geographic data bases. The second technology presents 3-D subsurface analyses and displays of groundwater and contaminant measurements within waste areas. In the third application, aerial survey information is being used to characterize land cover and vegetative patterns, detect change, and study areas of previous waste activities and possible transport pathways. These computer technologies are required to manage, analyze, and display the large amounts of environmental and geographic data that must be handled in carrying out effective environmental restoration.

27389 (DOE/ER/60253–9) **Rangeland – plant response to elevated CO_2: Progress report, 1993.** Owensby, C.E.; Coyne, P.I.; Ham, J.M.; Parton, W.; Rice, C.; Auen, L.M.; Adam, N. Kansas State Univ., Manhattan, KS (United States). Dept. of Agronomy. 1993. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-84ER60253. Order Number DE93017058. Source: OSTI; NTIS; INIS; GPO Dep.

Plots of a tallgrass prairie ecosystem were exposed to ambient and twice-ambient CO_2 concentrations in open-top chambers and compared to unchambered ambient CO_2 plots during the entire growing season from 1989 through 1992. Relative root production among treatments was estimated using root ingrowth bags which remained in place throughout the growing season. Latent heat flux was simulated with and without water stress. Botanical composition was estimated annuallyin all treatments. Open-top chambers appeared to reduce latent heat flux and increase water use efficiency similar to elevated CO_2 when water stress was not severe, but under severe water stress, chamber effect on water use efficiency was limited. In natural ecosystems with periodic moisture stress, increased water use efficiency under elevated CO_2 apparently would have a greater impact on productivity than photosynthetic pathway. Root ingrowth biomass was greater in 1990 and 1991 on elevated CO_2 plots compared to ambient or chambered-ambient plots. In 1992, there was no difference in root ingrowth biomass among treatments.

27390 (DOE/ER/60633–8) **Mass and energy budgets of animals: Behavioral and ecological implications: Annual technical progress report, April 1, 1992–March 31, 1993.** Porter, W.P. Wisconsin Univ., Madison, WI (United States). [1993]. 46p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-88ER60633. Order Number DE93016205. Source: OSTI; NTIS; GPO Dep.

The common goal of these diverse projects is to understand the mechanisms of how animal populations respond to the continual changes in their environment in both time and space. Our models are mechanistic allowing us to explore how a wide array of environmental variables may determine individual performance. Large scale climate change and its effect on animal populations can be seen as quantitative extensions of biological responses to smaller scales of environmental variability. Changes in developmental rates or reproductive levels of individuals, extension or contraction of geographic ranges, and modification of community organization have all been documented in response to previous changes in habitats. We know from our biophysical work that some changes in function are driven by microclimate conditions directly, and some are mediated indirectly through ecological parameters such as the food supply. Our research is guided by a comprehensive conceptual

scheme of the interaction of an animal with its environment. The physical and physiological properties of the organism, and the range of available microclimates, set bounds on the performance of organismal function, such as growth, reproduction, storage, and behavior. To leave the most offspring over a lifetime, animals must perform those functions in a way that maximizes the amount of resources devoted to reproduction. Maximizing the total size of the budget and minimizing those budget items not devoted to reproduction are crucial. Animals trade off among expenditures for current and future reproduction. Both water and energy are important, potentially limiting resources. Projects described here include empirical studies and theoretical models.

27391 (DOE/ER/60665–T2) **An investigation of the geology and geochemistry of radon in shear zones.** Schumann, R.R. (Geological Survey, Denver, CO (United States)); Stanton, M.R.; Gundersen, L.C.S.; Gates, A.E.; Schultz, A.P.; Speer, J.A. Geological Survey, Denver, CO (United States). [1991]. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AI05-88ER60665. Order Number DE93014397. Source: OSTI; NTIS; GPO Dep.

In this study we will characterize the four principal geologic terrains that cause the highest and most extensive indoor radon problems in the United States, we will predict their national distribution, and we will define the climatic and chemical processes that affect uranium and radium siting in rocks and soils, and ultimately their emanation and radon potential. We have chosen nine sheared granite plutons from different climatic areas across the United States, two faulted carbonate terrains from an and area and a humid area, and three sites within the fractured Pierre shale and the glacial deposits derived from it in the northern Great Plains. The results of our studies for the last four years have established that in order to understand and accurately predict radon transport and availability in rocks, soils, and ground water, the factors affecting radon emanation must be quantitatively described and basic models developed to understand the processes involved. Three phases of the project were worked on this (1) Preliminary assessment of the Alleghenian granites and compilation of data for establishing the relation between heat flow and radon production and availability, (2) development of a field emanation protocol, and (3) ongoing geochemical examination of shear zone processes.

27392 (DOE/ID/13042–5) **A comparative evaluation of conceptual models for the Snake River Plain aquifer at the Idaho Chemical Processing Plant, INEL.** Prahl, C.J. Idaho INEL Oversight Program, Boise, ID (United States). Jan 1992. 136p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG07-91ID13042. Order Number DE93012948. Source: OSTI; NTIS; INIS; GPO Dep.

Thesis submitted to Univ. of Idaho, Moscow, ID.

Geologic and hydrologic data collected by the United States Geological Survey (USGS) are used to evaluate the existing ground water monitoring well network completed in the upper portion of the Snake River Plain aquifer (SRPA) beneath the Idaho Chemical Processing Plant (ICPP). The USGS data analyzed and compared in this study include: (a) lithologic, geophysical, and stratigraphic information, including the conceptual geologic models intrawell, ground water flow measurement (Tracejector tests) and (c) dedicated, submersible, sampling group elevations. Qualitative evaluation of these data indicate that the upper portion of the SRPA is both heterogeneous and anisotropic at the scale of the ICPP monitoring well network. Tracejector test results indicate that the hydraulic interconnection and spatial configuration of water-producing zones is extremely complex within the upper portion of the SRPA. The majority of ICPP monitoring wells currently are equipped to sample ground water only the upper lithostratigraphic intervals of the SRPA, primarily basalt flow groups E, EF, and F. Depth-specific hydrogeochemical sampling and analysis are necessary to determine if ground water quality varies significantly between the various lithostratigraphic units adjacent to individual sampling pumps.

27393 (DOE/ID/13042–7) **Moscow Test Well, INEL Oversight Program: Aqueous geochemistry.** McCurry, M. (Idaho State Univ., Pocatello, ID (United States)); Fromm, J.; Welhan, J. Idaho INEL Oversight Program, Boise, ID (United States). 29 Sep 1992. 41p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG07-91ID13042. Order Number DE93012950. Source: OSTI; NTIS; INIS; GPO Dep.

This report presents a summary and interpretation of data gathered during sampling of the Moscow Test Well at Moscow, Idaho during April and May of 1992. The principal objectives of this chemical survey were to validate sampling procedures with a new straddle packer sampling tool in a previously hydrologically well characterized and simple sampling environment, and to compare analytical results from two independent labs for reproducibility of analytical results. Analytes included a wide range of metals, anions, nutrients, BNA's, and VOC's. Secondary objectives included analyzing of waters from a large distilled water tank (utilized for all field laboratory purposes as "pure" stock water), of water which passed through a steamer used to clean the packer, and of rinsates from the packer tool itself before it was lowered into the test well. Analyses were also obtained of blanks and spikes for data validation purposes.

27394 (DOE/NV/10845–18) **A study of the homogenization of soils.** Giovine, L.R.S.; Miller, F.L. Jr. Nevada Univ., Las Vegas, NV (United States). Water Resources Center. Jun 1993. 27p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC08-90NV10845. Order Number DE93017132. Source: OSTI; NTIS; GPO Dep.

In accordance with US Environmental Protection Agency (US EPA) regulations, areas of land that have been contaminated must be returned to an environmental condition that permits less restrictive forms of use. In anticipation of being listed as an EPA Superfund Site, the United States Department of Energy's (US DOE) Nevada Test Site (NTS) is evaluating existing the technologies, and supporting the development of new technologies, for the removal of plutonium contaminants from soils. During the 1950s, DOE conducted a series of tests on the NTS wherein attempts were made to detonate nuclear weapons by igniting charges of high explosives packed around the weapons' warheads. While the warheads never achieved criticality, each test disseminated particulate plutonium over several square miles, principally in Area 11 of the NTS.DOE's Nevada Operations Office has committed to a Plutonium In Soils Integrated Demonstration Project (PuID) to evaluate existing and developmental technologies for the safe removal of plutonium contamination from soils. It is DOE's intention to provide approximately one ton of Area 11 soil, traced with a non-radioactive plutonium surrogate, to each of several companies with expertise in the removal of soil contaminants. These companies have expressed an interest in contracting with DOE for remediation of NTS soils. DOE wishes to evaluate each company's process in an unbiased and statistically justifiable manner. For this reason, DOE must provide to each company a large sample of soil for prototype testing. The soil must be homogenized such that the representativeness of each split is well documented and defensible. The process of uniformly mixing large volumes of soil has not been addressed, to our knowledge, in the hydrogeologic, soil science or mining literature. Several mixing devices are currently being evaluated by DOE for use in the PuID. This report describes the results of some initial experimentation with a small cement mixer.

27395 (DOE/NV/10845–T17) **Archaeological investigations at sample unit U19ax, Nevada Test Site, Nye County, Nevada.** Beck, C.M.; Johnson, W.G.; McArthur, R.D. (eds.); Drollinger, H.; McLane, A.R.; Nowack, C.; Pippin, L.C. Nevada Univ., Reno, NV (United States). Quaternary Sciences Center. 1992. 72p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC08-90NV10845. Order Number DE93015947. Source: OSTI; NTIS; GPO Dep.

This report documents the procedures and findings of archaeological investigations sample unit U19ax on Pahute Mesa, Nevada Test Site. Data recovery was conducted at sites 26NY4182, 26NY5428, 26NY7842, and 26NY7843. The investigation consisted of mapping and surface collection. Four surface artifact concentrations were defined, three it site 26NY4182 and one at site 26NY7843. Only chipped-stone and groundstone artifacts were recovered. Lithic technology at these locales was perceived to be primarily core reduction and biface thinning, possibly of intermediate stage biface production. The time frame for occupancy of the

area ranges from Early Archaic to Historic based on temporally diagnostic artifacts and radiocarbon dates. The greatest intensity of occupation seems to be around the late Middle Archaic and the early Late Archaic. The test excavation at site 26NY5428 revealed significant cultural deposits that can contribute to the research objectives of the Long Range Study Plan for the archaeological work on Pahute Mesa. The site possesses stratified deposits and datable material. Radiocarbon dates place the site in the Middle and Late Archaic periods. Based on data from the test excavation, site 26NY5428 may be viewed as the primary locus of settlement and subsistence strategies within the immediate area. Due to large pieces of rockfall covering portions of the site, full-scale excavations are not possible at this time. Full-scale excavation of site 26NY5428 is recommended if no comparable site is found in other sample units.

27396 (DOE/NV/10845–T18) **Archaeological data recovery at drill hole U19az, Nevada Test Site, Nye County, Nevada.** Lancaster, J. Nevada Univ., Reno, NV (United States). Quaternary Sciences Center. 1992. 47p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC08-90NV10845. Order Number DE93015948. Source: OSTI; NTIS; GPO Dep.

At the request of the Department of Energy, Nevada Field Office (DOE/NV), the Desert Research Institute (DRI) conducted archaeological data recovery at drill hole U19az on the Nevada Test Site in February 1988 and April 1990. The work focused on a site that was recommended as eligible to the National Register of Historic Places. DOE/NV chose to mitigate adverse impacts to the site though a data recovery program. The mapping and collection of artifacts took place in two discrete areas, covering almost 10 hectares (24.71 acres). In addition to surface collection, 11 test pits and 12 surface scrapes were excavated. Information was sought to address four research questions concerned with the age of the site, the subsistence and demography of the site's inhabitants, and the behavioral implications of their lithic technology. This report describes and presents the results of the data recovery at drill hole U19az. The analyses of the artifacts indicate that the site was inhabited between 5,000 years ago and historic times. Relative artifact abundance indicates the most intense use occurred from about 4,000 to 1,500 years ago.

27397 (DOE/NV/10845–T19) **Fire on the mesa: Archaeological investigations at the U19an borrow pit on the Nevada Test Site.** Amick, D.S. Nevada Univ., Reno, NV (United States). Quaternary Sciences Center. Dec 1992. 118p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC08-90NV10845. Order Number DE93015949. Source: OSTI; NTIS; GPO Dep.

In 1984, the Desert Research Institute conducted an archaeological reconnaissance of a proposed borrow pit area known as U19an(bp) on the Nevada Test Site for the Department of Energy, Nevada Field Office. During this reconnaissance, four National Register quality archaeological sites were discovered and recorded as lithic scatter sites 26NY4201-4204. The DRI proposed that these sites should be avoided, or investigated if avoidance was not feasible. Analysis of the surface assemblages from U19an(bp) indicates that this area was used repeatedly over the past several thousand years for domestic activities, resource processing, and hunting. Dispersed lithic reduction stations are also scattered across the area. This report presents findings relevant to several issues that have not been considered in detail in previous archaeological studies of the NTS. Notably, a detailed discussion of the lithic reduction system utilized in the production of chalcedony bifaces is presented. In addition, the role of thermal alteration in local lithic technology is considered and the evidence for thermally fractured artifacts is investigated. The data recovered from U19an(bp) indicate that fire may have played a significant role in local site formation.

27398 (DOE/OR–01-1136) **Annual report on the Background Soil Characterization Project on the Oak Ridge Reservation, Oak Ridge, Tennessee: Results of Phase 1 investigation.** Watkins, D.R. (Oak Ridge National Lab., TN (United States)); Goddard, P.L.; Hatmaker, T.L.; Hook, L.A.; Jackson, B.L.; Kimbrough, C.W.; Lee, S.Y.; Lietzke, D.A.; McGin, C.W.; Nourse, B.D.; Schmoyer, R.L.; Shaw, R.A.; Stinnette, S.E.; Switek, J.; Wright, J.Oak Ridge National Lab., TN (United States). May 1993. 445p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. (ES/ER/TM–43). Order Number DE93014394. Source: OSTI; NTIS; INIS; GPO Dep.

Many constituents of potential concern for human health occur naturally at low concentrations in undisturbed soils. The Background soil Characterization Project (BSCP) was undertaken to provide background concentration data on potential contaminants in natural soils on the Oak Ridge Reservation (ORR). The objectives of the BSCP are to provide baseline data for contaminated site assessment and estimates of potential human health risk associated with background concentrations of hazardous and other constituents in native soils. This report presents, evaluates, and documents data and results obtained in Phase I of the project. It is intended to be a stand-alone document for application and use in structuring and conducting remedial investigation and remedial action projects in the Environmental Restoration (ER) Program.

27399 (DOE/SR/15191–5) **Wildlife management assistance report: Progress report, July 1, 1991–June 30, 1992.** Caudell, M.B. South Carolina Wildlife and Marine Resources Dept., Columbia, SC (United States). May 1992. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG09-87SR15191. Order Number DE93015565. Source: OSTI; NTIS; GPO Dep.

Thirty-four days were spent administering hunts on Crackerneck Wildlife Management Area with 1773 people participating. Biological data was collected on 76 deer, eight wild turkeys, 33 feral hogs, 58 ducks of two species, 75 gray squirrels, 4 raccoons, 9 bobwhites, and 484 fish of 9 species. Serving as a Coordinating Land User for the SRS Site Use Committee entailed evaluating 81 land use proposals with regard to effects on wildlife populations. The antlerless deer quota program continued in the district with 129 landowners in Aiken, Barnwell, and Orangeburg Counties being approved for antlerless harvest which required field investigations, acreage verification at tax offices, and personal correspondence. Bait sites for turkey trapping were maintained on the SRS for two months. Wildlife census work was conducted on wild turkey, bobwhite, mourning dove, furbearers, fox squirrels, and bald eagles on the SRS and in Aiken and Barnwell Counties. Three wetlands in Aiken County were evaluated for suitability with regard to wood duck boxes. Two wetland environmental review notices for the SRS were evaluated. Additional work on Wildlife Management Area land included reposting 50 miles of boundary in Aiken and Lexington County and removing signs form several tracts lost from the program. Future recommendations for the turkey and regulations brochures were submitted and WMA maps covering Aiken and Lexington Counties were updated.

27400 (EGG–10617-1242) **An aerial radiological survey of the Ames Laboratory and surrounding area, Ames, Iowa: Date of survey: July 1991.** Maurer, R.J. EG and G Energy Measurements, Inc., Las Vegas, NV (United States). Remote Sensing Lab. Apr 1993. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC08-93NV11265. Order Number DE93016140. Source: OSTI; NTIS; INIS; GPO Dep.

An aerial radiological survey of the Ames Laboratory and surrounding area in Ames, Iowa, was conducted during the period July 15–25, 1991. The purpose of the survey was to measure and document the terrestrial radiological environment at the Ames Laboratory and the surrounding area for use in effective environmental management and emergency response planning. The aerial survey was flown at an altitude of 200 feet (61 meters) along a series of parallel lines 350 feet (107 meters) apart. The survey encompassed an area of 36 square miles (93 square kilometers) and included the city of Ames, Iowa, and the Iowa State University. The results are reported as exposure rates at 1 meter above ground level (inferred from the aerial data) in the form of a gamma radiation contour map. Typical background exposure rates were found to vary from 7 to 9 microroentgens per hour (μR/h). No anomalous radiation levels were detected at the Ames Laboratory. However, one anomalous radiation source was detected at an industrial storage yard in the city of Ames. In support of the aerial survey, ground-based exposure rate and soil sample measurements were obtained at several sites within the survey perimeter. The results of the aerial and ground-based measurements were found to agree within the expected uncertainty of $\pm$15%.

27401 (EGG-EEL–10498) **A modeling study of contaminant transport resulting from flooding of Pit 9 at the Radioactive Waste Management Complex, Idaho National Engineering Laboratory.** Magnuson, S.O.; Sondrup, A.J. EG and G Idaho, Inc., Idaho Falls, ID (United States). Sep 1992. 40p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. Order Number DE93016668. Source: OSTI; NTIS; INIS; GPO Dep.

A simulation study was conducted to determine if dissolved-phase transport due to flooding is a viable mechanism for explaining the presence of radionuclides in sedimentary interbeds below the Radioactive Waste Management Complex. In particular, the study focused on ^{241}Am migration due to flooding of Pit 9 in 1969. A kinetically-controlled source term model was used to estimate the mass of ^{241}Am that leached as a function of a variable surface infiltration rate. This mass release rate was then used in a numerical simulation of unsaturated flow and transport to estimate the advance due to flooding of the ^{241}Am front down towards the 110 ft interbed. The simulation included the effect of fractures by superimposing them onto elements that represented the basalt matrix. For the base case, hydraulic and transport parameters were assigned using the best available data. The advance of the ^{241}Am front due to flooding for this case was minimal, on the order of a few meters. This was due to the strong tendency for ^{241}Am to sorb onto both basalts and sediments. In addition to the base case simulation, a parametric sensitivity study was conducted which tested the effect of sorption in the fractures, in the kinetic source term, and in the basalt matrix. Of these, the only case which resulted in significant transport was when there was no sorption in the basalt matrix. The indication being that other processes such as transport by radiocolloids or organic complexation may have contributed. However, caution is advised in interpreting these results due to approximations in the numerical method that was used incorporate fractures into the simulation. The approximations are a result of fracture apertures being significantly smaller than the elements over which they are superimposed. The sensitivity of the ^{241}Am advance to the assumed hydraulic conductivity for the fractures was also tested.

27402 (EGG-EELS–10666) **Software quality assurance plan for PORFLOW-3D.** Maheras, S.J. EG and G Idaho, Inc., Idaho Falls, ID (United States). Mar 1993. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. Order Number DE93012331. Source: OSTI; INIS; NTIS (documentation only); ESTSC (complete software package), P.O. Box 1020, Oak Ridge, TN 37831-1020; GPO Dep.

This plan describes the steps taken by the Idaho National Engineering Laboratory Subsurface and Environmental Modeling Unit personnel to implement software quality assurance procedures for the PORFLOW-3D computer code. PORFLOW-3D was used to conduct radiological performance assessments at the Savannah River Site. software quality assurance procedures for PORFLOW-3D include software acquisition, installation, testing, operation, maintenance, and retirement. Configuration control and quality assurance procedures are also included or referenced in this plan.

27403 (EGG-M–92586) **A new probe for in situ TDR moisture measurement.** Yokuda, E. (EG and G Idaho, Inc., Idaho Falls, ID (United States)); Smith, R. EG and G Idaho, Inc., Idaho Falls, ID (United States). [1993]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. (CONF-930561–5: 39. international instrumentation symposium, Albuquerque, NM (United States), 2-6 May 1993). Order Number DE93013681. Source: OSTI; NTIS; INIS; GPO Dep.

This paper explains the development of a new Time Domain Reflectometry (TDR) probe which can be inserted through waste and soil to a depth of 14 feet with minimal labor and minimal soil disturbance. TDR has been used for 10 years as a method for measuring soil moisture contents. Conventional TDR probes are 30 centimeters long and therefore are difficult to insert at depths below a few feet. Recently, a probe has been developed which can be inserted to depths of 14 feet with the use of a vibratory drill. Quality objectives for the instrument, preliminary data, and suggestions for future developments are presented.

27404 (EMO–1096-Vol.2) **Shemya AFB, Alaska 1992 IRP field investigation report: Volume 2, Appendix A: Final report.** Pacific Northwest Lab., Richland, WA (United States). Environmental Management Operations; Air Force Alaskan Air Command, Elmendorf AFB, AK (United States); CH2M Hill, Boise, ID (United States). Feb 1993. 673p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract AC06-76RL01830. DEU-91-06. Order Number DE93011969. Source: OSTI; NTIS; INIS; GPO Dep.

The US Air Force is currently investigating 22 sites on Shemya Air Force Base (AFB) to determine if past spill and disposal activities have caused environmental damage. These investigations are being carried out under the Air Force's Installation Restoration Program (IRP). Field investigations were performed in 1992 to obtain the information needed to assess what future actions will need to be carried out at each site. The island's drinking water supply was also investigated. Activities completed at 10 selected sites during the 1992 field investigation included surface sampling to determine the lateral extent of contamination, subsurface sampling to determine the vertical extent of contamination, and the installation of well points and monitoring wells to determine the direction of groundwater flow and if the groundwater has been affected by a site. In addition, geophysical surveys were performed at most sites to identify site boundaries and check for the presence of buried metal to be avoided during drilling activities. This report, appendix A, contains the analytical results.

27405 (ENEA-RT-AMB–92-16) **Environmental radioactivity measurements around ENEA's Brasimone center.** Cazzoli, S.; Lorenzelli, R.; Salvi, S. ENEA, Bologna (Italy). Area Energia Ambiente e Salute. Jun 1992. 28p. (In Italian). (RT/AMB–92-16). Order Number DE93799294. Source: OSTI; NTIS (US Sales Only); INIS.

This paper reports the values of the 1987 radioactivity analysis on environmental and food chain matrixes, in the area of the Brasimone Centre (Bologna). Descriptions are also given of the collecting, treating and testing methods for various matrixes analysed. This ENEA (Italian Agency for Energy, New Technologies and Environment) nuclear lab complex was intended to serve the nearby PEC nuclear power station whose completion has been developed due to the Italian moratorium on nuclear power.

27406 (ESH-EMS–920037) **The Savannah River Site's Groundwater Monitoring Program: Third quarter 1992.** Rogers, C.D. (Westinghouse Savannah River Co., Aiken, SC (United States)). Westinghouse Savannah River Co., Aiken, SC (United States); Exploration Resources, Inc., Athens, GA (United States). 4 Feb 1993. 876p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93015366. Source: OSTI; NTIS; INIS; GPO Dep.

The Environmental Protection Department/Environmental Monitoring Section (EPD/EMS) administers the Savannah River Site's (SRS) Groundwater Monitoring Program. During third quarter 1992, EPD/EMS conducted extensive sampling of monitoring wells. Table 1 lists those well series with constituents in the groundwater above Flag 2 during third quarter 1992, organized by location. Results from all laboratory analyses are used to generate this table. Specific conductance and pH data from the field also are included in this table.

27407 (ETDE-IT–93-175) **Evaluation of trace and minor elements in agricultural products from Italian farms, by instrumental neutron activation analysis.** Moauro, A.; Triolo, L.; Avino, P.; Ferrandi, L. ENEA, Casaccia (Italy). Area Energia e Innovazione. 1992. 8p. (CONF-9209369–1: 8. international colloquium for the optimization of plant nutrition, Lisbon (Portugal), 1-5 Sep 1992). Order Number DE93799194. Source: OSTI; NTIS (US Sales Only).

Instrumental neutron activation analysis (INAA) was used to determine non- destructively as many as 25 minor and trace elements in some crops collected from Italian farms, in different pollution conditions. For quantitative evaluations, some reference materials were used, prepared by a group of 38 Analytical Institutes (CII) and analyzed in an inter-comparison campaign. No large differences were found among the examined areas, but a comparison among our values, and those recommended or considered provisionally safe by WHO, showed that our data for Cr, Co and

Cu exceeded these limits. The largest values were found for tobacco leaves collected in an agricultural area of central Italy.

27408 (GTK-YST–81) **Mise-a-la-Masse measurements and galvanic connections as a part of flow path investigations at Palmottu U-Th-mineralization, southwestern Finland.** Paananen, M. Geological Survey of Finland, Espoo (Finland). 1993. [37p.] (In Finnish). Order Number DE93629306. Source: OSTI; NTIS; INIS.

Nuclear Waste Disposal Research.

The Palmottu U-Th-mineralization at Nummi-Pusula, southwestern Finland has been the subject of natural analogue studies for radionuclide migration since 1987. The mobilization, migration and sorption phenomena of radionuclides in crystalline bedrock in the area have been investigated. In the work, the galvanic and possible hydraulic connections between drill holes are studied by the charged potential-method (mise-a-la-masse), in which a current source is grounded at an interesting structure in a drill hole and the potential is sounded in another drill hole in the vicinity of the grounding. A galvanic connection to the current source can possibly seen as a potential maxima. The measurements have mostly been carried out in two drilling profiles in ten drill holes with fifteen current grounding positions. A total of 35 separate potential soundings were carried out. Possibly hydraulically significant sections (intense fracturing, low resistivity) were chosen as grounding positions. Fracture zones that possibly cut the mineralization were of special interest.

27409 (HW–18321) **A rapid, simple method for the determination of the radon content of water.** Thorburn, R.C.; Healy, J.W. Hanford Works, Richland, WA (United States). 29 Jun 1950. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93017358. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The historical approach to the separation of radon from water is liberation of the radon from the sample by boiling under vacuum in the presence of a strong acid; flushing the liberated radon, with an inert gas, into an ionization chamber or an alpha proportional counters and measuring the collected activity. Such an analysis requires a manipulation time of approximately one hour, a waiting period of two to three hours before measurement to allow transitory equilibrium to be reached, and finally a measurement time, resulting in 4 to 6 hours for one analysis. In addition, specialized equipment including a vacuum train is required. If it is desired to count the alpha particles from radon and its daughters in a proportional counter, absorption trains to remove all oxygen, a poor counting gas, are required. The method presented herein requires only 20–25 minutes for a complete analysis and except for the beta counter utilizes standard laboratory equipment.

27410 (INIS-mf–12758, pp. 704-709) **Radionuclides sorption in clay soils.** Siraky, G. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina). Gerencia de Seguridad Radiologica y Nuclear); Lewis, C.; Hamlat, S.; Nollmann, C.E. Asociacion Argentina de Tecnologia Nuclear, Buenos Aires (Argentina). 1987. [735p.] (In Spanish). (CONF-8711355–: 15. scientific meeting and 4th Latin American meeting and 1st sessions on nuclear power plants, San Carlos de Bariloche (Argentina), 2-6 Nov 1987). In *Proceedings of the fifteenth scientific meeting; fourth Latin American meeting; first sessions on nuclear power plants.* Order Number DE91003052. Source: OSTI; NTIS (US Sales Only); INIS.

The sorption behaviour of clay soils is examined through a parametric study of the distribution coefficient (Kd) for the radionuclides of interest, Cs and Sr. This work is a preliminary stage of the migration studies of these nuclides in a porous medium (ground of Ezeiza, Argentina) and the evaluation of radiologic impact of the removal of low and intermediate activity wastes in shallow trenches. The determination of Kd is performed by a static technique or batch. The phases are separated by centrifugation at 20000 g during 1 hour. The activity of supernatant solution of Cs-137 and Sr-85 is measured in a detecting system of I Na(Tl) well-type. Two types of parameters were changed: (a) those related to the determination method: phase separation (centrifugation vs. centrifugation plus filtration); equilibrium period, ratio solid/liquid; (b) those related to the geochemical system: pH of contact solution, carrier concentration, competitive ions, ionic strength, desorption. It was observed that the modification of parameters in the Kd-measurement does not change the order of magnitude of results. (Author).

27411 (INIS-mf–13541, pp. 35) **The reflection of geodynamic process in the variations of radon concentration in earth, before the earthquake in Egypt, 12.10.1992.** Finkelstein, M. (Tel Aviv Univ. (Israel). Research Inst. for Environmental Health); Neeman, E. Israel Geological Society, Jerusalem (Israel). Mar 1993. [173p.] (CONF-9303169–: Israel Geological Society annual meeting, Arad (Israel), 15 Mar 1993). In *Israel Geological Society annual meeting, 1993.* Order Number DE93627928. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. GEOPHYSICS/radon; DAILY VARIATIONS; EARTH CRUST; GEOPHYSICS; RADON; RADIOACTIVITY

27412 (INIS-mf–13541, pp. 33) **Migration stratification of hydrocarbons in Yam 1 and Yam 2.** Feinstein, S. (Ben-Gurion Univ. of the Negev, Beersheba (Israel)); Aizenshtat, Z.; Miloslavski, I.; Slager, J.; Gerling, P.; Snowdon, L. Israel Geological Society, Jerusalem (Israel). Mar 1993. [173p.] (CONF-9303169–: Israel Geological Society annual meeting, Arad (Israel), 15 Mar 1993). In *Israel Geological Society annual meeting, 1993.* Order Number DE93627928. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. GEOLOGIC HISTORY/natural gas fields; CARBON 13; RESERVOIR FLUIDS

27413 (INIS-mf–13541, pp. 22) **The diagenesis history of Heletz formation and the timing of hydrocarbon accumulation in Heletz-Kokhav oil field.** Calvo, R. (Hebrew Univ., Jerusalem (Israel)); Ayalon, A.; Bein, A.; Sass, E. Israel Geological Society, Jerusalem (Israel). Mar 1993. [173p.] (CONF-9303169–: Israel Geological Society annual meeting, Arad (Israel), 15 Mar 1993). In *Israel Geological Society annual meeting, 1993.* Order Number DE93627928. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. GEOLOGIC HISTORY/israel; ISRAEL; ISOTOPE DATING; PALEOZOIC ERA

27414 (INIS-mf–13541, pp. 30) **The development of the metamorphic basement of the Sinai massif as revealed by the U-Pb ages.** Eyal, M. (Ben-Gurion Univ. of the Negev, Beersheba (Israel)). Israel Geological Society, Jerusalem (Israel). Mar 1993. [173p.] (CONF-9303169–: Israel Geological Society annual meeting, Arad (Israel), 15 Mar 1993). In *Israel Geological Society annual meeting, 1993.* Order Number DE93627928. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. EGYPTIAN ARAB REPUBLIC/precambrian era; GEOLOGIC MODELS; ISOTOPE DATING

27415 (INIS-mf–13541, pp. 41) **$\delta^{34}S$ and high amonia contents in the rift valley springs: indicators for sulfate reduction and decomposition of organic matter.** Gavrieli, I. (Geological survey of Israel, Jerusalem (Israel)); Bein, A. Israel Geological Society, Jerusalem (Israel). Mar 1993. [173p.] (CONF-9303169–: Israel Geological Society annual meeting, Arad (Israel), 15 Mar 1993). In *Israel Geological Society annual meeting, 1993.* Order Number DE93627928. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. GEOCHEMISTRY/dead sea; ELEMENT ABUNDANCE; GEOCHEMISTRY; HYDROGEN SULFIDES; HYDROTHERMAL SYSTEMS; SULFATES; SULFUR 34

27416 (INIS-mf–13541, pp. 82) **Stable-isotopic signatures and tectonic correlation: A new statistical approach and application to the Cyclades.** Lieberman, J. (Hebrew Univ., Jerusalem (Israel)); Matthews, A.; Ganor, J. Israel Geological Society, Jerusalem (Israel). Mar 1993. [173p.] (CONF-9303169–: Israel Geological Society annual meeting, Arad (Israel), 15 Mar 1993). In *Israel Geological Society annual meeting, 1993.* Order Number DE93627928. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. GEOLOGIC HISTORY/greece; CARBON 13; GREECE; ISOTOPE RATIO; OXYGEN 18

27417 (INIS-mf–13541, pp. 51) **Ar-Ar dating of anorthite and sanidine fels from hatrurim fm. in Arad: Age spectra and their interpretation.** Gur, D. (Geological survey of Israel, Jerusalem (Israel)); Steinitz, G.; Starinsky, A.; Kolodny, Y. Israel Geological Society, Jerusalem (Israel). Mar 1993. [173p.] (CONF-9303169–: Israel Geological Society annual meeting, Arad (Israel), 15 Mar

1993). In *Israel Geological Society annual meeting, 1993.* Order Number DE93627928. Source: OSTI; NTIS (US Sales Only); INIS.
Short communication. GEOLOGIC DEPOSITS/isotope dating; FELDSPARS; ISRAEL

27418 (INIS-mf–13541, pp. 60) **$^{40}Ar/^{39}Ar$ dating of prehistoric basalts in southwest Syria.** Heimann, A. (Ohio State Univ., Columbus, OH (United States). Dept. of Geology); Foland, K.A.; Mor, D.; Stein, M. Israel Geological Society, Jerusalem (Israel). Mar 1993. [173p.] (CONF-9303169–: Israel Geological Society annual meeting, Arad (Israel), 15 Mar 1993). In *Israel Geological Society annual meeting, 1993.* Order Number DE93627928. Source: OSTI; NTIS (US Sales Only); INIS.
Short communication. BASEMENT ROCK/isotope dating; BASALT; ISRAEL

27419 (INIS-mf–13541, pp. 67) **K-Ar age authigenic feldspar from cenomanian hazera formation.** Kapusta, J. (Geological Survey of Israel, 30 Malkhe Yisrael Street, Jerusalem (Israel)); Sandler, A.; Kotlarski, P.; Steinitz, G. Israel Geological Society, Jerusalem (Israel). Mar 1993. [173p.] (CONF-9303169–: Israel Geological Society annual meeting, Arad (Israel), 15 Mar 1993). In *Israel Geological Society annual meeting, 1993.* Order Number DE93627928. Source: OSTI; NTIS (US Sales Only); INIS.
Short communication. FELDSPARS/isotope dating; GEOLOGY/israel; FELDSPARS; GEOLOGY; ISRAEL

27420 (INIS-mf–13541, pp. 13) **The Sir-10 ground penetrating radar system: Application survey.** Beck, A. (The institute for petroleum research and geophysics, Holon (Israel)). Israel Geological Society, Jerusalem (Israel). Mar 1993. [173p.] (CONF-9303169–: Israel Geological Society annual meeting, Arad (Israel), 15 Mar 1993). In *Israel Geological Society annual meeting, 1993.* Order Number DE93627928. Source: OSTI; NTIS (US Sales Only); INIS.
Short communication. PETROLEUM GEOLOGY/radiometric surveys

27421 (INIS-mf–13541, pp. 103) **Age determination of pedogenic carbonate nodules using electron spin resonance.** Porat, N. (Geological Survey of Israel, Jerusalem (Israel)); Zilberman, E.; Amit, R. Israel Geological Society, Jerusalem (Israel). Mar 1993. [173p.] (CONF-9303169–: Israel Geological Society annual meeting, Arad (Israel), 15 Mar 1993). In *Israel Geological Society annual meeting, 1993.* Order Number DE93627928. Source: OSTI; NTIS (US Sales Only); INIS.
Short communication. AGE ESTIMATION/geologic deposits; CARBONATES; GEOLOGIC HISTORY

27422 (INIS-mf–13541, pp. 126) **The use of natural radioactivity for tracing sediments from the Jordan river to lake Kinneret.** Shteinman, B. (Kinneret limnological laboratory, Tiberias (Israel)); Gutman, A. Israel Geological Society, Jerusalem (Israel). Mar 1993. [173p.] (CONF-9303169–: Israel Geological Society annual meeting, Arad (Israel), 15 Mar 1993). In *Israel Geological Society annual meeting, 1993.* Order Number DE93627928. Source: OSTI; NTIS (US Sales Only); INIS.
Short communication. SEDIMENTS/environmental transport; GAMMA SPECTROSCOPY; NATURAL RADIOACTIVITY; SEDIMENTARY BASINS; SEDIMENTS

27423 (INIS-mf–13541, pp. 128) **$^{230}Th/^{232}Th$ and Pb isotopes in prehistoric and quaternary basalts from southwest-Syria and northern Israel: Interferences for the Th/U ratio of the plume beneath the northern arabian plate.** Stein, M. (Hebrew Univ., Jerusalem (Israel)); Heimann, A.; Hemond, C. Israel Geological Society, Jerusalem (Israel). Mar 1993. [173p.] (CONF-9303169–: Israel Geological Society annual meeting, Arad (Israel), 15 Mar 1993). In *Israel Geological Society annual meeting, 1993.* Order Number DE93627928. Source: OSTI; NTIS (US Sales Only); INIS.
Short communication. GEOLOGIC DEPOSITS/isotope dating; BASALT

27424 (INIS-mf–13541, pp. 129) **Direct-dating of the sedimentary sequence in Israel using the K-Ar method: Interim report.** Steinitz, G. (Geological Survey of Israel, Jerusalem (Israel)); Kapusta, J.; Kotlarsky, P. Israel Geological Society, Jerusalem (Israel). Mar 1993. [173p.] (CONF-9303169–: Israel Geological Society annual meeting, Arad (Israel), 15 Mar 1993). In *Israel Geological Society annual meeting, 1993.* Order Number DE93627928. Source: OSTI; NTIS (US Sales Only); INIS.
Short communication. GEOLOGIC STRATA/isotope dating; FELDSPARS; ISRAEL; SEDIMENTS

27425 (INIS-mf–13541) **Israel Geological Society annual meeting 1993.** Gavrieli, Ittai (ed.) (Geological Survey of Israel, Jerusalem (Israel)). Israel Geological Society, Jerusalem (Israel). Mar 1993. [173p.] (CONF-9303169–: Israel Geological Society annual meeting, Arad (Israel), 15 Mar 1993). Order Number DE93627928. Source: OSTI; NTIS (US Sales Only); INIS.
The publication includes abstracts of the geological researches.

27426 (INIS-mf–13542) **Soil transfer function obtention by Wiener's optimum filter.** Flores Ruiz, J.H. Instituto Nacional de Investigaciones Nucleares, Mexico City (Mexico). 1987. [17p.] (In Spanish). (CONF-8706430–: 3. Seminarium EII, MPI, NINI on Technological Specialities., Salazar (Mexico), 11 Jun 1987). Order Number DE93629307. Source: OSTI; NTIS (US Sales Only); INIS.
Transfer function in nuclear power plant Laguna Verde, Veracruz, using Wiener filter. This paper deal with identification of complex structural and soil-interaction systems often are modeling in nuclear industry. Nonparametric identification techniques are used to analyse the response of a class nonlinear vibrations. Efficient computational algorithms and experimental techniques based input-output system methods such as the Wiener-Kernel approach and least-square regression techniques are applied to get the transfer function in nuclear power plant Laguna Verde, Veracruz (Mexico) (Author).

27427 (INIS-mf–13543, pp. 14-22) **Radioactivity of rocks.** Matolin, M. (Karlova Univ., Prague (Czech Republic). Prirodovedecka Fakulta). Ministerstvo Zivotniho Prostredi, Prague (Czech Republic); Okresni Urad, Jihlava (Czech Republic); Dum Kultury Odboru, Jihlava (Czech Republic). 1992. (In Czech). (CONF-9211241–: Conference on provisions against radon, Jihlava (Czech Republic), 23-25 Nov 1992). In *Conference on provisions against radon: Proceedings.* [232p.] Order Number DE93629294. Source: OSTI; NTIS (US Sales Only); INIS.
Radioactive isotopes of uranium, thorium and potassium are major sources of the Earth's radiation. The average concentrations of the three elements in the Earth's crust are 2-4 ppm, 8-12 ppm, and 2.5%, respectively. Field measurements of radioactivity of rocks, which are mainly concerned with the detection of gamma rays, are performed from airplanes or cars, manually, in bores and by analyzing rock samples. The radioactivity of various rock massifs in the Czech and in the Slovak Republic is given. The gamma dose rate in air in the Bohemian Massif region is about 70 nGy/h, in the West Carpathians region, 50 nGy/h. (M.D.) 2 tabs., 1 fig.

27428 (INIS-mf–13543, pp. 161-180) **Specific activities of natural radionuclides in building materials.** Kominek, A. (Vyzkumny Ustav Stavebnich Hmot, Brno (Czech Republic)); Breda, M.; Thomas, J. Ministerstvo Zivotniho Prostredi, Prague (Czech Republic); Okresni Urad, Jihlava (Czech Republic); Dum Kultury Odboru, Jihlava (Czech Republic). 1992. (In Czech). (CONF-9211241–: Conference on provisions against radon, Jihlava (Czech Republic), 23-25 Nov 1992). In *Conference on provisions against radon: Proceedings.* [232p.] Order Number DE93629294. Source: OSTI; NTIS (US Sales Only); INIS.
A brief survey of papers dealing with natural radioactivity and radon is presented, and an overview of institutions concerned with this subject is given. The existing results of measurement of specific activities of natural radionuclides in building raw materials are summarized. An extensive table of specific activities of building materials is reproduced, as is a table of emanation coefficients of building materials. A survey of binding and recommended values, limits, standards and regulations is also given. (M.D.). Tabs.

27429 (KCP–613-5152) **Process waste assessment: Petroleum jelly removal from semiconductor die using trichloroethylene.** Curtin, D.P. Allied-Signal Aerospace Co.,

Kansas City, MO (United States). Kansas City Div. May 1993. 28p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00613. Order Number DE93015596. Source: OSTI; NTIS; INIS; GPO Dep.

The process analyzed involves non-production, laboratory environment use of trichloroethylene for the cleaning of semiconductor devices. The option selection centered on the replacement of the trichloroethylene with a non-hazardous material. This process waste assessment was performed as part of a pilot project.

27430 (LA-UR–93-2326) **The importance of zeolites in the potential high-level radioactive waste repository at Yucca Mountain, Nevada.** Vaniman, D.T.; Bish, D.L. Los Alamos National Lab., NM (United States). 1993. 24p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9306100–2: Zeolite 93: 4th international conference on the occurrence, properties, and utilization of natural zeolites, Boise, ID (United States), 20-28 Jun 1993). Order Number DE93016459. Source: OSTI; NTIS; GPO Dep.

Zeolitic rocks play an important role in retarding the migration of radionuclides that occur in solution as simple cations (Cs, Sr, Ba). However, the interaction of zeolites with complex transuranic species in solution provides little if any advantage over other common silicate minerals. The most important consequences of zeolite occurrences near a high-level radioactive waste repository environment are likely to be their response to thermal loading and their impact on site hydrology. Partial zeolite dehydration during the early thermal pulse from the repository and rehydration as the repository slowly cools can have an important impact on the water budget of a repository in unsaturated rocks, provided that the long-term heating does not result in zeolite destabilization.

27431 (LBL–32418) **Analysis of flow processes during TCE infiltration in heterogeneous soils at the Savannah River Site, Aiken, South Carolina.** Pruess, K. Lawrence Berkeley Lab., CA (United States). Jun 1992. 41p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. Order Number DE93015266. Source: OSTI; NTIS; GPO Dep.

Contamination of soils and groundwater from volatile organic compounds (VOCs), such as organic solvents and hydrocarbon fuels, is a problem at many industrial facilities. Key to successfully characterizing, containing, and eventually remediating the contamination is a thorough understanding, based on sound scientific principles, of the complex interplay of physical, chemical, and biological processes in geologic media, which affect the migration and distribution of the contaminants, and their response to remediation operations. This report focusses on physical mechanisms that affect contaminant behavior under the conditions encountered at the Savannah River site (SRS). Although other contaminants are present at the site, for the purpose of this discussion we will restrict ourselves to the processes following a spill and infiltration of trichloroethylene (TCE), which is the main contaminant at the location of the Integrated Demonstration Project. We begin by briefly describing the main physical processes following release of TCE into the subsurface. Subsequently we will present simple engineering models that can help to evaluate contaminant migration processes in a semi-quantitative way. Finally, we will discuss results of detailed numerical simulations of TCE infiltration into a heterogeneous medium consisting of sands and clays. These simulations attempt to shed light on the initial distribution of contaminants at the site prior to the start of remediation operations. We also point out limitations of present numerical modeling capabilities, and identify issues that require further research in order that a realistic description of contaminant behavior in the subsurface may be achieved.

27432 (LBL–33957) **Applicability of petroleum horizontal drilling technology to hazardous waste site characterization and remediation.** Goranson, C. Lawrence Berkeley Lab., CA (United States). Sep 1992. 90p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. Order Number DE93015270. Source: OSTI; NTIS; INIS; GPO Dep.

Horizontal wells have the potential to become an important tool for use in characterization, remediation and monitoring operations at hazardous waste disposal, chemical manufacturing, refining and other sites where subsurface pollution may develop from operations or spills. Subsurface pollution of groundwater aquifers can occur at these sites by leakage of surface disposal ponds, surface storage tanks, underground storage tanks (UST), subsurface pipelines or leakage from surface operations. Characterization and remediation of aquifers at or near these sites requires drilling operations that are typically shallow, less than 500-feet in depth. Due to the shallow nature of polluted aquifers, waste site subsurface geologic formations frequently consist of unconsolidated materials. Fractured, jointed and/or layered high compressive strength formations or compacted caliche type formations can also be encountered. Some formations are unsaturated and have pore spaces that are only partially filled with water. Completely saturated underpressured aquifers may be encountered in areas where the static ground water levels are well below the ground surface. Each of these subsurface conditions can complicate the drilling and completion of wells needed for monitoring, characterization and remediation activities. This report describes some of the equipment that is available from petroleum drilling operations that has direct application to groundwater characterization and remediation activities. A brief discussion of petroleum directional and horizontal well drilling methodologies is given to allow the reader to gain an understanding of the equipment needed to drill and complete horizontal wells. Equipment used in river crossing drilling technology is also discussed. The final portion of this report is a description of the drilling equipment available and how it can be applied to groundwater characterization and remediation activities.

27433 (NUREG–0837-Vol.13-No.1) **NRC TLD Direct Radiation Monitoring Network: Progress report, January–March 1993: Volume 13, No. 1.** Struckmeyer, R.; McNamara, N. Nuclear Regulatory Commission, King of Prussia, PA (United States). Region I. May 1993. 228p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Source: OSTI; NTIS; INIS; GPO.

This report provides the status and results of the NRC Thermoluminescent Dosimeter (TLD) Direct Radiation Monitoring Network. It presents measured in the vicinity of NRC licensed facilities throughout the country for the first quarter of 1993.

27434 (NUREG/CR–5996) **Subsurface injection of radioactive tracers: Field experiment for model validation testing.** Fayer, M.J. (Pacific Northwest Lab., Richland, WA (United States)); Sisson, J.B.; Jordan, W.A.; Lu, A.H.; Heller, P.R. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Regulatory Applications; Pacific Northwest Lab., Richland, WA (United States). Feb 1993. 48p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC06-76RL01830. (PNL–8499). Source: OSTI; NTIS; INIS; GPO.

Accurate predictions of the movement of radioactive contaminants from disposal facilities are required to evaluate effects, optimize data collection, design remediation strategies and predict the long-term results of such strategies. A field experiment was undertaken in 1980 and 1981 to provide data to test the limits of model predictions. The purpose of this report is to provide a complete record of data generated during that field experiment for use as a model validation test case. The report combines the information in Sisson and Lu (1984) with unpublished laboratory and field data on the hydraulic properties of the sediments and core data collected at the end of the experiment The unique features of this experiment were the documented control of the inputs, the three-dimensional nature of the experiment, the measurement of radioactive tracers in situ, and the use of multiple injections. The in situ monitoring methods were neutron moderation for water content and gamma energy analysis for tracer concentration. The data are provided on 3.5-in. diskettes. The data include observation and injection well construction details, injection solution concentrations, radioactive tracer and water content distributions in space and time, neutron probe calibration information, and sediment properties determined in both the laboratory and field.

27435 (NUREG/CR–6041) **Disposal Unit Source Term (DUST) data input guide.** Sullivan, T.M. (Brookhaven National Lab., Upton, NY (United States)). Nuclear Regulatory Commission, Washington, DC (United States). Div. of Low-Level Waste Management and Decommissioning; Brookhaven National Lab., Upton, NY

(United States). May 1993. 197p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC02-76CH00016. (BNL-NUREG–52375). Source: OSTI; NTIS; INIS; GPO.

Performance assessment of a low-level waste (LLW) disposal facility begins with an estimation of the rate at which radionuclides migrate out of the facility (i.e., the source term). The focus of this work is to develop a methodology for calculating the source term. In general, the source term is influenced by the radionuclide inventory, the wasteforms and containers used to dispose of the inventory, and the physical processes that lead to release from the facility (fluid flow, container degradation, wasteform leaching, and radionuclide transport). The computer code DUST (Disposal Unit Source Term) has been developed to model these processes. This document presents the models used to calculate release from a disposal facility, verification of the model, and instructions on the use of the DUST code. In addition to DUST, a preprocessor, DUSTIN, which helps the code user create input decks for DUST and a post-processor, GRAFXT, which takes selected output files and plots them on the computer terminal have been written. Use of these codes is also described.

27436 (OEFZS–4620) **The lysimeter device of the Austrian Research Centre Seibersdorf.** Gerzabek, M.H. (Hauptabteilung Agrarforschung und Biotechnologie, Forschungszentrum Seibersdorf GmbH, Seibersdorf (Austria)). Oesterreichisches Forschungszentrum Seibersdorf GmbH (Austria). Mar 1992. [6p.] (In German). Order Number DE93628436. Source: OSTI; NTIS (US Sales Only); INIS.

Reprint from the Proceedings of the Lysimeter Conference, Gumpenstein, Austria, April 16th 1991.

A device for taking soil samples to be used for studies of radionuclide migration from soil to plants is described.

27437 (OEFZS–4664) **Radiation surveyance actions following large-area contamination.** Malasek, A. (Hauptabteilung fuer Schulung und Ausbildung, Bereich Marketing, Forschungszentrum Seibersdorf GmbH, Seibersdorf (Austria)). Oesterreichisches Forschungszentrum Seibersdorf GmbH (Austria). Dec 1992. [15p.] (In German). Order Number DE93628041. Source: OSTI; NTIS (US Sales Only); INIS.

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'Radiation monitoring' is understood to comprise all activities leading to the prompt quantitative and qualitative comprehension and evaluation of locally limited contamination situations due to diverse causes. The results of 'radiation monitoring' form the basis for the establishment of the kind and scope of protective measures to be taken on behalf of the persons concerned or the population in general. Generally, areas easily accessible by car or by foot, as well as urban areas, should be rather monitored by ground survey, while remote areas hardly accessible by car or by foot should by monitored from the air. Monitoring procedures and monitoring methods preferred for a certain area in the case of emergency should already now be defined in emergency plans. To assure the quick and easy availability of staff and of the required equipment and vehicles, as well as their precise and rational employment, the training and practice activities have to be designed according to these plans. A up-to-date digital communication and evaluation system would be of advantage. (author).

27438 (OEFZS–4666) **The soil-to-plant transfer of radionuclides. Feasibilities and limits of the transfer concept.** Gerzabek, M.H. (Hauptabteilung Agrarforschung und Biotechnologie, Forschungszentrum Seibersdorf GmbH, Seibersdorf (Austria)). Oesterreichisches Forschungszentrum Seibersdorf GmbH (Austria). Jan 1993. [22p.] (In German). Order Number DE93628021. Source: OSTI; NTIS (US Sales Only); INIS.

Provided with ISSN 0253-5270.

The present paper discusses the simple transfer model. After the Chernobyl fallout in Austria field investigations dealt with the behavior of radionuclides in the soil-plant system. They led to the following conclusions: (1) A single plowing does not result in a homogeneous radionuclide distribution in the A_p horizon. (2) Low plant availability of radionuclides (e.g. ^{137}Cs) led to a higher contribution of outer contamination (resuspension) to concentrations in plants in the first years after the fallout. Differences arose between high and low contamination areas. This was not true for ^{90}Sr, which exhibited three to ten times higher transfer factors as compared to ^{137}Cs. (3) The contamination source has a distinct impact on the plant availability of radionuclides. (4) In semi-natural environments radiocesium can be bound to the biomass to a great extent, which results in significantly higher biological half-lives as compared to agricultural ecosystems. (author).

27439 (ORNL/FTR–4369) **Travel to the Netherlands to participate in a workshop held by the World Inventory of Soil Emissions (WISE) project at the International Soil Reference and Information Centre (ISRIC): Foreign trip report, August 22–29, 1992.** Post, W.M. Oak Ridge National Lab., TN (United States). 14 Sep 1992. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93012246. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The concentrations of so-called "greenhouse gases" are increasing in the atmosphere. The conditions and processes that regulate the emission of the natural trace gases from terrestrial ecosystems are not fully understood. The World Inventory of Soil Emissions (WISE) Project, funded by the Netherlands National Research Programme on Global Air Pollution and Climate Change, is developing a computerized soil data base with spatial resolution of $\frac{1}{2}$ by $\frac{1}{2}$ degree to contain soil information necessary for estimating soil carbon dynamics, terrestrial ecosystem carbon dynamics, and emissions of the trace gases CO_2, NH_4 and N_2O. The traveler was an invited participant in a workshop that assembled leading investigators in soil research and global change that developed an appropriate methodology for assembling data and models to complete the WISE Project objectives. Successful completion of the WISE Project will result in an important resource for global carbon cycle research sponsored by DOE at ORNL and for the international scientific community.

27440 (ORNL/FTR–4413) **Travel to the United Kingdom and Italy to present keynote lectures and technical talks at two international meetings on the role of natural organic matter in the environment and to learn about recent advances in this area relevant to the traveler's research: Foreign trip report, September 10–26, 1992.** McCarthy, J.F. Oak Ridge National Lab., TN (United States). 2 Oct 1992. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93011664. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The traveler presented keynote lectures and technical presentations at the International Conference on Organic Substances in Soil and Water and the Sixth International Humic Substances Society (IHSS) Meeting. At the Organic Substances Conference, the traveler presented a keynote lecture entitled "Subsurface Transport of Dissolved Organic Matter: Implications for Contaminant Mobility" and a technical presentation on humic acids as mass fractals. At the IHSS meeting, the traveler presented a keynote lecture entitled "The Significance of Interactions of Humic Acids and Organisms in the Environment" and two poster presentations on field studies on organic matter. Other presentations of interest to the traveler are described, including studies of cotransport of contaminants in soil, advances in characterization of natural organic matter (NOM), and interactions of NOM with colloid and aquifer surfaces.

27441 (ORNL/FTR–4426) **[Rothamsted model for turnover of soil organic matter]: Foreign trip report, October 7–9, 1992.** Post, W.M. Oak Ridge National Lab., TN (United States). 26 Oct 1992. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93009931. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The traveler gave an invited presentation at the Global Soil Database Workshop in Silsoe detailing a soil organic matter data base assembled over 10 years ago as a collaborative project between ORNL and University of California, Berkeley. The scientific communities addressing issues in global biogeochemical cycles, including trace gas exchange and effects of the land surface water and energy balance on climate, require global maps of soil properties. The current global data bases are inadequate for defining

properties such as texture and organic matter content. The workshop outlined a new global soils data base that focuses on soil properties and not on soil classification. Such a map will make the quality of soils information more uniform and hence more useful for global modeling.

27442 (ORNL/FTR–4452) **Monitoring and evaluation of the Guatemalan Mission's natural resources strategic objective: Foreign trip report, September 13–30, 1992.** Shonder, J.A. Oak Ridge National Lab., TN (United States). 26 Oct 1992. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93009942. Source: OSTI; NTIS (US Sales Only); GPO Dep.

At the request of the Guatemalan Mission of the US Agency for International Development, the traveler went to Guatemala City to assist in the development of a plan for monitoring and evaluation of the Mission's natural resources strategic objective. The activity, which was carried out over a two and one-half week period, involved review of documentation for projects managed under the strategic objective, discussions with program managers, preparation of a draft document outlining the monitoring and evaluation plan, and a final oral presentation of the draft plan. A trip was made to Flores, Guatemala to determine the availability of photographs which will be used to document deforestation trends in the Department of Peten, Guatemala.

27443 (ORNL/FTR–4455) **Environmental contamination in Central and Eastern Europe: Foreign trip report, October 10–17, 1992.** Haas, J.W. III. Oak Ridge National Lab., TN (United States). 3 Nov 1992. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93009936. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Papers were presented at the symposium describing advances in environmental monitoring developed by the Measurement Systems Research Group at Oak Ridge National Laboratory. Plenary sessions describing the state of the environment in Eastern Europe and technical sessions on sampling and monitoring methods, site characterization, field screening and remote sensing methods, site remediation, control technologies, analytical methods, and radiological contamination were attended.

27444 (ORNL/FTR–4510) **[Environmental impact analyses on current and planned Antarctic operations and research activities]: Foreign trip report, October 19–November 20, 1992.** McCold, L.N.; Ensminger, J.T. Oak Ridge National Lab., TN (United States). 17 Dec 1992. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93009784. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Lance N. McCold and J. Tim Ensminger travelled to Antarctica at the request of the National Science Foundation for the purpose of gaining first hand knowledge of the major environmental issues related to the US antarctic research activities and support operations. The NSF's activities were evaluated under the requirements of the Madrid Protocol that Antarctica be protected for its own intrinsic value and its unique usefulness for future scientific research. Several activities in the vicinity of McMurdo Station and the South Pole Station were identified as potentially requiring environmental impact analyses.

27445 (ORNL/FTR–4552) **[Travel to US field stations in Antarctica in preparation for environmental impact studies]: Foreign trip report, January 4–February 22, 1993.** Webb, J.W.; Easterly, C.E. Oak Ridge National Lab., TN (United States). 24 Mar 1993. 14p. Sponsored by National Science Foundation, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93011815. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The travelers flew to Antarctica at the request of the National Science Foundation (NSF) for the purpose of gaining firsthand knowledge of the major environmental issues related to the US Antarctic research activities and support operations. The NSF's activities were evaluated under the requirements of the Madrid Protocol that Antarctica be protected for its own intrinsic value and its unique usefulness for future scientific research. The visit was planned to augment and extend investigations by L. N. McCold and J. T. Ensminger of ORNL undertaken in October and November 1992, respectively. Several activities in the vicinity of McMurdo Station and the South Pole Station were surveyed for possible future environmental impact analyses.

27446 (ORNL/TM–12048) **Management plan for the Oak Ridge Reservation Hydrology and Geology Study Groundwater Data Base.** Thompson, B.K. Oak Ridge National Lab., TN (United States). Apr 1993. 21p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93014341. Source: OSTI; NTIS; GPO Dep.

The Oak Ridge Reservation Hydrology and Geology Study (ORRHAGS) Groundwater Data Base has been compiled to consolidate groundwater data from the three US Department of Energy facilities located on the Oak Ridge Reservation: the Oak Ridge K-25 Site, the Oak Ridge National Laboratory, and the Oak Ridge Y-12 Plant. Each of these facilities maintains its own groundwater and well construction data bases. Data were extracted from the existing data bases, converted to a consistent format, and integrated into the ORRHAGS Groundwater Data Base structures. This data base management plan documents the development and maintenance of the ORRHAGS Groundwater Data Base and contains information on data base objectives; roles and responsibilities of the personnel involved; and flow, updating, and storage of the data.

27447 (ORNL/TM–12142) **Comparison of three field screening techniques for delineating petroleum hydrocarbon plumes in groundwater at a site in the southern Carson Desert, Nevada.** Smuin, D.R. Oak Ridge National Lab., TN (United States). Jan 1993. 134p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93012428. Source: OSTI; NTIS; INIS; GPO Dep.

Three types of field screening techniques used in the characterization of potentially contaminated sites at Naval Air Station Fallon, Nevada, are compared. The methods and results for each technique are presented. The three techniques include soil-gas surveys, electromagnetic geophysical surveys, and groundwater test hole screening. Initial screening at the first study site included two soil-gas surveys and electromagnetic geophysical studies. These screening methods identified l areas of contamination; however, results were inconclusive. Therefore groundwater test hole screening was performed. Groundwater screening consisted of auger drilling down to the shallow alluvial aquifer. Groundwater samples were collected from the open drill hole with a bailer. On-site head-space analyses for volatile organic compounds (VOCS) were performed using a portable gas chromatograph (GC). Five areas of floating petroleum hydrocarbon product were identified along with the overall dissolved contaminant plume boundaries. Well placement was re-evaluated, and well sites were relocated based on the screening information. The most effective technique for identification of petroleum hydrocarbon-contaminant plumes was groundwater test hole screening. Groundwater screening was subsequently performed at 19 other sites. A total of 450 test holes were analyzed resulting in the delineation of six plumes.

27448 (ORNL/TM–12177) **Selective leaching of uranium from uranium-contaminated soils: Progress report 1.** Francis, C.W.; Mattus, A.J.; Farr, L.L.; Elless, M.P.; Lee, S.Y. Oak Ridge National Lab., TN (United States). Feb 1993. 59p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93010428. Source: OSTI; NTIS; INIS; GPO Dep.

Environmental Sciences Division Publication No. 3980.

Three soils and a sediment contaminated with uranium were used to determine the effectiveness of sodium carbonate and citric acid leaching to decontaminated or remove uranium to acceptable regulatory levels. Two of the soils were surface soils from the DOE facility formerly called the Feed Materials Production Center (FMPC) at Fernald, Ohio. This facility is presently called the Fernald Environmental Management Project (FEMP). Carbonate extractions generally removed from 70 to 90% of the uranium from the Fernald storage pad soil. Uranium was slightly more difficult to extract from the Fernald incinerator and the Y-12 landfarm soils. Very small amounts of uranium could be extracted from the storm sewer sediment. Extraction with carbonate at high solution-to-soil ratios were as effective as extractions at low solution-to-soil ratios,

indicating attrition by the paddle mixer was not significantly different than that provided in a rotary extractor. Also, pretreatments such as milling or pulverizing the soil sample did not appear to increase extraction efficiency when carbonate extractions were carried out at elevated temperatures (60°C) or long extraction times (23 h). Adding $KMnO_4$ in the carbonate extraction appeared to increase extraction efficiency from the Fernald incinerator soil but not the Fernald storage pad soil. The most effective leaching rates (> 90 % from both Fernald soils) were obtained using a citrate/dithionite extraction procedure designed to remove amorphous (noncrystalline) iron/aluminum sesquioxides from surfaces of clay minerals. Citric acid also proved to be a very good extractant for uranium.

27449 (ORNL/TM–12324) **An inventory of wells of Oak Ridge National Laboratory 1992.** Rush, R.M.; Gryder, R.K.; Baxter, F.P. Oak Ridge National Lab., TN (United States). Feb 1993. 187p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93014151. Source: OSTI; NTIS; INIS; GPO Dep.

The well inventory described in this report is a database of well information being developed for the Oak Ridge National Laboratory (ORNL) Groundwater Coordinator and the ORNL Groundwater Protection Program. Data are presented on 2071 ORNL wells as maps and as tabular data. A table of well identification aliases is given to permit correlation with earlier reports. Information is incomplete for many of the wells, and a form is provided for readers to provide missing or updated data. The goal of the developers of this data base is to produce a comprehensive inventory of wells at ORNL. This data base is being maintained to provide current information for the operational management of the ORNL groundwater monitoring system and for various users of groundwater data at ORNL.

27450 (PNL–6415-Rev.5) **Hanford Site National Environmental Policy Act (NEPA) Characterization: Revision 5.** Cushing, C.E. (ed.). Pacific Northwest Lab., Richland, WA (United States). Dec 1992. 209p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93010161. Source: OSTI; NTIS; INIS; GPO Dep.

This fifth revision of the Hanford Site National Environmental Policy (NEPA) Characterization presents current environmental data regarding the Hanford Site and its immediate environs. This information is intended for use in preparing Site-related NEPA documentation. Information is presented on climate and meteorology, geology and hydrology, ecology, history and archaeology, socioeconomics, land use, and noise levels, prepared by Pacific Northwest Laboratory (PNL) staff. Models are described that are to be used in simulating realized or potential impacts from nuclear materials at the Hanford Site. Included are models of radionuclide transport in groundwater and atmospheric pathways, and of radiation dose to populations via all known pathways from known initial conditions. Federal and state regulations, DOE orders and permits, and environmental standards directly applicable for the NEPA documents at the Hanford Site, are provided.

27451 (PNL–8334) **Cost/benefit analysis comparing ex situ treatment technologies for removing carbon tetrachloride from Hanford groundwater.** Truex, M.J.; Brown, D.R.; Elliott, D.B. Pacific Northwest Lab., Richland, WA (United States). May 1993. 42p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93013934. Source: OSTI; NTIS; INIS; GPO Dep.

Pacific Northwest Laboratory conducted a cost/benefit and performance analysis to compare ex situ technologies that can be used to destroy the carbon tetrachloride (CCl_4) in the ground water of Hanford's 200 West Area. The objective of this work was to provide a direct quantitative and qualitative comparison of competing technologies. The technologies examined included a biological system, the Thermochemical Environmental Energy System II (TEES II), and a UV/oxidation system. The factors examined included key system operation parameters, impact on inorganic contaminants in the ground water, and secondary waste production. The cost effectiveness of these destruction technologies was also compared to the cost for an air stripping/granular activated carbon (AS/GAC) system. While the AS/GAC system appeared to be more cost effective at many levels than the CCl_4 destruction technologies, the secondary waste produced by this system may lead to significant cost and/or regulatory problems. The factors with the greatest influence on cost for each destruction technology are as follows: nutrient requirements for both of the biological systems, electricity requirements and the type of unit operations for the TEES II process, and electricity requirements for UV/oxidation.

27452 (PNL–8478) **Soil erosion rates caused by wind and saltating sand stresses in a wind tunnel.** Ligotke, M.W. Pacific Northwest Lab., Richland, WA (United States). Feb 1993. 83p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93009154. Source: OSTI; NTIS; INIS; GPO Dep.

Wind erosion tests were performed in a wind tunnel in support of the development of long-term protective barriers to cap stabilized waste sites at the Hanford Site. Controlled wind and saltating sand erosive stresses were applied to physical models of barrier surface layers to simulate worst-case eolian erosive stresses. The goal of these tests was to provide information useful to the design and evaluation of the surface layer composition of an arid-region waste site barrier concept that incorporates a deep fine-soil reservoir. A surface layer composition is needed that will form an armor resistant to eolian erosion during periods of extreme dry climatic conditions, especially when such conditions result in the elimination or reduction of vegetation by water deprivation or wildfire. Because of the life span required of Hanford waste barriers, it is important that additional work follow these wind tunnel studies. A modeling effort is planned to aid the interpretation of test results with respect to the suitability of pea gravel to protect the finite-soil reservoir during long periods of climatic stress. It is additionally recommended that wind tunnel tests be continued and field data be obtained at prototype or actual barrier sites. Results wig contribute to barrier design efforts and provide confidence in the design of long-term waste site caps for and regions.

27453 (PNL–8500-Pt.2) **Pacific Northwest Laboratory annual report for 1992 to the DOE Office of Energy Research: Part 2, Environmental sciences.** Grove, L.K. (ed.); Wildung, R.E. Pacific Northwest Lab., Richland, WA (United States). Mar 1993. 232p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93013932. Source: OSTI; NTIS; INIS; GPO Dep.

The 1992 Annual Report from Pacific Northwest Laboratory (PNL) to the US Department of Energy (DOE) describes research in environment and health conducted during fiscal year 1992. This report consists of four volumes oriented to particular segments of the PNL program, describing research performed for the DOE Office of Health and Environmental Research in the Office of Energy Research. The parts of the 1992 Annual Report are: Biomedical Sciences; Environmental Sciences; Atmospheric Sciences; and Physical Sciences. This Report is Part 2: Environmental Sciences. Included in this report are developments in Subsurface Science, Terrestrial Science, Laboratory-Directed Research and Development, Interactions with Educational Institutions, Technology Transfer, Publications, and Presentations. The research is directed toward developing a fundamental understanding of subsurface and terrestrial systems as a basis for both managing these critical resources and addressing environmental problems such as environmental restoration and global change. The Technology Transfer section of this report describes a number of examples in which fundamental research is laying the groundwork for the technology needed to resolve important environmental problems. The Interactions with Educational Institutions section of the report illustrates the results of a long-term, proactive program to make PNL facilities available for university and preuniversity education and to involve educational institutions in research programs. The areas under investigation include the effect of geochemical and physical phenomena on the diversity and function of microorganisms in deep subsurface environments, ways to address subsurface heterogeneity, and ways to determine the key biochemical and physiological pathways (and DNA markers) that control nutrient, water, and energy dynamics in arid ecosystems and the response of these systems to disturbance and climatic change.

27454 (PNL–8580) **Water level measurements for modeling hydraulic properties in the 300-FF-5 and 100 Aggregate Area Operable units.** Campbell, M.D.; McMahon, W.J.; Simpson, K.R.

Pacific Northwest Lab., Richland, WA (United States). Apr 1993. 68p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93010929. Source: OSTI; NTIS; INIS; GPO Dep.

Pressure transducers connected to dataloggers were used to measure ground water and Columbia River water elevations simultaneously and hourly at 35 locations in the 300-FF-5 Operable Unit and 16 locations in the 100 Aggregate Area Operable Unit on the Hanford Site. Water temperatures were also measured at 12 of these locations. This report details the findings of these studies.

27455 (PNL–8654) **Columbia River monitoring: Summary of chemical monitoring along cross sections at Vernita Bridge and Richland.** Dirkes, R.L.; Patton, G.W.; Tiller, B.L. Pacific Northwest Lab., Richland, WA (United States). May 1993. 31p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93014149. Source: OSTI; NTIS; GPO Dep.

This report presents the results of the chemical monitoring performed by the Surface Environmental Surveillance Project (SESP) along cross sections of the Columbia River established at Vernita Bridge and the Richland Pumphouse. Potential Hanford-origin chemical constituents of interest were selected based on their presence in ground water near the river, past surveillance efforts that have documented their entry into the river, and reviews of special study reports, CERCIA remedial investigation/feasibility study (RI/FS) documentation, RCRA facility investigation/corrective measure (FI/CW) study plans, and preliminary risk assessments. Results presented in this report include volatile organic compounds, metals, and anions. The data were generated as part of the routine Columbia River monitoring program currently conducted as part of the SESP.

27456 (PNL–8675) **A comparison of simulation models for predicting soil water dynamics in bare and vegetated lysimeters.** Link, S.O.; Kickert, R.N.; Fayer, M.J.; Gee, G.W. Pacific Northwest Lab., Richland, WA (United States). Jun 1993. 31p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93016575. Source: OSTI; NTIS; GPO Dep.

This report describes the results of simulation models used to predict soil water storage dynamics at the Field Lysimeter Test Facility (FLTF) weighing lysimeters. The objectives of this research is to develop the capability to predict soil water storage dynamics with plants in support of water infiltration control studies for the Hanford Permanent Isolation Barrier Development Program. It is important to gain confidence in one's ability to simulate soil water dynamics over long time periods to assess the barrier's ability to prevent drainage. Two models were compared for their ability to simulate soil water storage dynamics with and without plants in weighing lysimeters, the soil water infiltration and movement (SWIM) and the simulation of production and utilization of rangelands (SPUR-91) models. These models adequately simulated soil water storage dynamics for the weighing lysimeters. The range of root mean square error values for the two models was 7.0 to 19.8. This compares well with the range reported by Fayer et al. (1992) for the bare soil data sets of 8.1 to 22.1. Future research will test the predictive capability of these models for longer term lysimeter data sets and for historical data sets collected in various plant community types.

27457 (PNL-SA–21614) **Fiber optic spectrochemical emission sensor: Detection of volatile chlorinated compounds in air and water using ultra-thin membranes.** Anheier, N.C. Jr.; Olsen, K.B.; Osantowski, R.E.; Evans, J.C. Jr.; Griffin, J.W. Pacific Northwest Lab., Richland, WA (United States). May 1993. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-930571–25: 183. Electrochemical Society meeting, Honolulu, HI (United States), 16-21 May 1993). Order Number DE93015699. Source: OSTI; NTIS; GPO Dep.

Prior work on the fiber optic spectrochemical emission sensor called HaloSnif™ has been extended to include an ultra-thin membrane which allows passage of volatile organic chlorinated compounds (VOCl). The membrane has been demonstrated to exclude H_2O during VOCl monitoring. The system is capable of measuring VOCl in gas-phase samples or aqueous solutions over a wide linear dynamic range. The lower limit of detection for trichloroethylene (TCE), perchloroethylene (PCE), carbon tetrachloride (CCl_4), and other related compounds in the gas-phase is 1 to 5 $ppm_{v/v}$, and in the aqueous-phase is 5 to 10 mg/L. Waste site characterization and remediation activities often require chemical analysis in the vadose zone and in groundwater. These analyses are typically performed in analytical laboratories using widely accepted standardized methods such as gas chromatography, gas chromatography/mass spectrometry. The new developments with HaloSnif provide rapid field screening which can augment the standardized methods.

27458 (SAND–92-2795C) **Full-field dye concentration measurement within saturated/unsaturated thin slabs of porous media.** Norton, D.L. (Arizona Univ., Tucson, AZ (United States). Dept. of Hydrology); Glass, R.J. Sandia National Labs., Albuquerque, NM (United States). [1992]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-930408–73: International high-level radioactive waste management conference, Las Vegas, NV (United States), 25-29 Apr 1993). Order Number DE93015014. Source: OSTI; NTIS; INIS; GPO Dep.

This paper presents a full-field dye concentration measurement technique that extends our experimental capabilities to the measurement of transient dye concentration fields within steady state flow fields under unsaturated or saturated conditions. Simple light absorption theory provides a basis for translating images into high resolution dye concentration fields. A series of dye pulse experiments that demonstrate the combined use of the full-field saturation and dye concentration techniques was conducted at four different degrees of saturation. Each of these experimental sequences was evaluated with respect to mass balance, the results being within 5% of the known dye mass input. An image windowing technique allowed us to see increased dispersion due to decreasing moisture content, tailing of concentration at the rear of the dye pulse and slight velocity changes of the dispersive front due to changes in moisture content. The exceptional resolution of dye concentration in space and time provided by this laboratory technique allows systematic experimentation for examining basic processes affecting solute transport within saturated/unsaturated porous media. Future challenges for this work will be to use these techniques to analyze more complex systems involving heterogeneities, scaling laws, and detailed investigations of the relationship between transverse and longitudinal dispersion in unsaturated media.

27459 (SAND–93-0100C) **Portable acoustic wave sensor systems for real-time monitoring of volatile organic compounds.** Cernosek, R.W.; Frye, G.C.; Gilbert, D.W. Sandia National Labs., Albuquerque, NM (United States). [1993]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-930557–1: Conference on physics computing, Albuquerque, NM (United States), 31 May - 4 jun 1993). Order Number DE93013753. Source: OSTI; NTIS; GPO Dep.

Portable acoustic wave sensor (PAWS) systems are being developed for real-time, on-line and in situ monitoring of volatile organic compounds (VOCs). These systems are built around surface acoustic wave (SAW) devices coated with viscoelastic polymers. Two independent responses of the SAW sensor, wave velocity and attenuation, are measured to provide information about the chemical species sorbed by the coating. Sensing is rapid and reversible, and coatings can be optimized for particular chemical selectivity and sensitivity. The complete PAWS system consists of two SAW devices (a sensor and a reference), RF oscillator electronics to drive the devices, digital interface/communications electronics, gas handling hardware to sample the environment, and a notebook computer to control the hardware and display responses in real-time. These systems have been demonstrated for on-line monitoring of exhaust stack vapors in environmentally conscious manufacturing (ECM) applications, for real- time documentation of off-gas contaminants from vacuum extraction processes at DOE remediation sites, and for down-hole sensing of volatile organics in vadose zone (above the groundwater level) monitoring wells.

27460 (UCRL-CR–110610) **Documentation and assessment of the history of the Lawrence Livermore National Laboratory Livermore facility, and site CA-SJO-173H, the Carnegie town**

site at Lawrence Livermore National Laboratory Site 300, Alameda and San Joaquin Counties, California. Lawrence Livermore National Lab., CA (United States); Weston (Roy F.), Inc., Albuquerque, NM (United States); Self (William) Associates, Orinda, CA (United States). Aug 1992. 105p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93009504. Source: OSTI; NTIS; INIS; GPO Dep.

This report examines the historic potential of two properties of the US Department of Energy's Lawrence Livermore National Laboratory (LLNL): the facility itself and a known historic archeological site, CA-SJO-173H, the Carnegie town site, contained within LLNL Site 300 in San Joaquin County, California. The history and development of LLNL is presented in Section 3 of the report, while Section 4 is devoted to the Carnegie historic site. Section 5 discusses aspects of the LLNL Livermore Site, as well as the Carnegie town site, in relation to the criteria for eligibility to the National Register of Historic Places contained in 36 CFR 60.4. Preliminary evaluations of National Register eligibility are presented. The recommendations contained in Section 6 define an appropriate avenue to permit the Department of Energy to consult with the State Historic Preservation Office, culminating in Determinations of Eligibility and Effect, if necessary, for the properties in question.

27461 (UCRL-JC–108210) **Holocene faulting near closed landfill Pit 6, Lawrence Livermore National Laboratory Site 300.** Carpenter, D.W. (Lawrence Livermore National Lab., CA (United States)); Taffet, M.J.; Copland, J.R.; Mateik, R.S.; Wade, W.M. Lawrence Livermore National Lab., CA (United States). Feb 1992. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9203247–1: 2. conference on earthquake hazards in the Eastern San Francisco Bay area, Hayward, CA (United States), 25-27 Mar 1992). Order Number DE93009529. Source: OSTI; NTIS; GPO Dep.

Lawrence Livermore National Laboratory's Site 300 test facility, an 11 mi^2 area, is located in the rugged, semiarid Altamont Hills southwest of Tracy, California. Geologic studies conducted at the site in support of environmental assessments of closed landfill Pit 6 reveal the presence of a fault strand showing evidence of repeated movements during late Pleistocene and Holocene time. These studies included airphoto interpretation, geologic mapping, and logging of four exploratory trenches and other exposures. The fault was traced from west of Pit 6 to southeast of the pit, a distance of about 1,500 ft; regional reconnaissance suggests that the fault extends beyond the limits of the area studied in detail. The identified fault strand is not coincident with any previously mapped fault. It occurs within a band of highly deformed Tertiary rocks that is bounded by the Carnegie fault on the north and the Corral Hollow fault on the south. Evidence of Holocene movement within the larger Corral Hollow-Carnegie fault zone indicates that this fault zone should be considered active and could be a source of future strong earthquake motion. Regressions relating total fault length, segment length, and fault plane area suggest that the Corral Hollow-Carnegie fault zone may be capable of generating an earthquake in the range of M_s 6.3 to 7.1. Effects of a strong earthquake on closed landfill Pit 6 would be expected to be slight since the identified Holocene fault trace passes at least 100 ft south of the outer limits of the pit area. However, the effects of strong ground shaking from a local source upon buildings, slopes, and other structures within Site 300 and vicinity should receive further consideration.

27462 (UCRL-JC–111993) **Innovative technologies for groundwater cleanup.** Yow, J.L. Jr. Lawrence Livermore National Lab., CA (United States). Sep 1992. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9209159–8: Eurocourse: technologies for environmental cleanup - soil and groundwater, Ispra (Italy), 21-25 Sep 1992). Order Number DE93013194. Source: OSTI; NTIS; INIS; GPO Dep.

These notes provide a broad overview of current developments in innovative technologies for groundwater cleanup. In this context, groundwater cleanup technologies include site remediation methods that deal with contaminants in ground water or that may move from the vadose zone into ground water. This discussion attempts to emphasize approaches that may be able to achieve significant improvements in groundwater cleanup cost or effectiveness. However, since data for quantitative performance and cost comparisons of new cleanup methods are scarce, preliminary comparisons must be based on the scientific approach used by each method and on the site-specific technical challenges presented by each groundwater contamination situation. A large number of technical alternatives that are now in research, development, and testing can be categorized by the scientific phenomena that they employ and by the site contamination situations that they treat. After reviewing a representative selection of these technologies, one of the new technologies, the Microbial Filter method, is discussed in more detail to highlight a promising in situ groundwater cleanup technology that is now being readied for field testing.

27463 (UCRL-JC–113510) **Radiolytic decomposition of environmental contaminants using an electron accelerator.** Matthews, S.M.; Boegel, A.J.; Caufield, R.A.; Jovanovich, M.C.; Loftis, J.A. Lawrence Livermore National Lab., CA (United States). Apr 1993. 23p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-930483–9: 9. waste minimization and pollution prevention conference, San Francisco, CA (United States), 13-15 Apr 1993). Order Number DE93014878. Source: OSTI; NTIS; INIS; GPO Dep.

Halogenated and nonhalogenated hydrocarbons are components of contamination currently found in natural waterways, ground water, and soils as a result of spills and careless disposal practices. The development of proper treatment methodologies for the waste streams producing this environmental damage is now a subject of growing concern. A significant number of these waste stream compounds are chemically stable and are thus resistant to environmental degradation. Numerous researchers have investigated the use of ionizing radiation to decompose chlorinated hydrocarbons in diverse matrices and have proposed various free-radical-induced reaction mechanisms. In this paper, we present results of experimentally measured radiolytically induced decomposition using accelerator-generated bremsstrahlung sources and gamma radiation from cobalt-60. Data are presented on the radiolytically induced reduction in concentration of volatile organic compounds (VOCs) dissolved in water and in air, polychlorinated biphenyl (PCB) dissolved in oil, high explosives dissolved in ground water, and chemical weapon surrogates. The results of these studies suggest the potential use of ionizing radiation as a method of hazardous waste treatment.

27464 (WSRC-MS–93-179) **Composite refraction-reflection stack sections: Tracing faults in the Atlantic coastal plain sediments.** Stephenson, D.E. (Westinghouse Savannah River Co., Aiken, SC (United States)); Coruh, C.; Costain, J.K. Westinghouse Savannah River Co., Aiken, SC (United States). [1993]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-930901–4: Annual meeting of the Society of Exploration Geophysicists, Washington, DC (United States), 26-30 Sep 1993). Order Number DE93013581. Source: OSTI; NTIS; GPO Dep.

Seismic data from the Atlantic Coastal Plain are reprocessed and composite refraction-reflection stack sections produced to investigate basement faults that penetrate upward into Atlantic Coastal Plain sediments in South Carolina. Reprocessing recovered reflections from within the deep crust to the Moho as well as from within thin veneer (300) of the Atlantic Coastal Plain sediments. One of the major objectives of this paper is to discuss the use of shallow refracted arrivals to construct a composite refraction- reflection stack that allows better imaging of the subsurface at shallow depths.

27465 (WSRC-MS–93-201) **Demonstration of risk-based decision analysis in remedial alternative selection and design.** Evans, E.K. (Geraghty and Miller Modeling Group, Reston, VA (United States)); Duffield, G.M.; Massmann, J.W.; Freeze, R.A.; Stephenson, D.E. Westinghouse Savannah River Co., Aiken, SC (United States). [1993]. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-9306158–1: 1993 groundwater modeling conference, Boulder, CO (United States), 6-12 Jun 1993). Order Number DE93013692. Source: OSTI; NTIS; INIS; GPO Dep.

This study demonstrates the use of risk-based decision analysis (Massmann and Freeze 1987a, 1987b) in the selection and design of an engineering alternative for groundwater remediation at a waste site at the Savannah River Site, a US Department of Energy facility in South Carolina. The investigation focuses on the remediation and closure of the H-Area Seepage Basins, an inactive disposal site that formerly received effluent water from a nearby production facility. A previous study by Duffield et al. (1992), which used risk-based decision analysis to screen a number of groundwater remediation alternatives under consideration for this site, indicated that the most attractive remedial option is ground-water extraction by wells coupled with surface water discharge of treated effluent. The aim of the present study is to demonstrate the iterative use of risk-based decision analysis throughout the design of a particular remedial alternative. In this study, we consider the interaction between two episodes of aquifer testing over a 6-year period and the refinement of a remedial extraction well system design. Using a three-dimensional ground-water flow model, this study employs (1) geostatistics and Monte Carlo techniques to simulate hydraulic conductivity as a stochastic process and (2) Bayesian updating and conditional simulation to investigate multiple phases of aquifer testing. In our evaluation of a remedial alternative, we compute probabilistic costs associated with the failure of an alternative to completely capture a simulated contaminant plume. The results of this study demonstrate the utility of risk-based decision analysis as a tool for improving the design of a remedial alternative through the course of phased data collection at a remedial site.

27466 (WSRC-RP–92-1397) **Preliminary site selection report for the new sanitary landfill at the Savannah River Site.** Westinghouse Savannah River Co., Aiken, SC (United States). Dec 1992. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93015379. Source: OSTI; NTIS; GPO Dep.

The Savannah River Site (SRS) has proposed a new sanitary landfill (NSL) for solid waste. A site selection team, comprised of representatives from Westinghouse Savannah River Company (WSRC) evaluated potential landfill sites. The site selection team conducted an initial screening of SRS to eliminate unsuitable areas. The screening was based on criteria that were principally environmental factors; however, the criteria also included avoiding areas with unacceptable features for construction or operation of the facility. This initial screening identified seven candidate sites for further evaluation.

27467 (WSRC-RP–93-459) **Projected tritium releases from F & H Area Seepage Basins and the Solid Waste Disposal Facilities to Fourmile Branch.** Looney, B.B.; Haselow, J.S.; Lewis, C.M.; Harris, M.K.; Wyatt, D.E.; Hetrick, C.S. Westinghouse Savannah River Co., Aiken, SC (United States). 15 Mar 1993. 25p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93014745. Source: OSTI; NTIS; INIS; GPO Dep.

A large percentage of the radioactivity released to the environment by operations at the Savannah River Site (SRS) is due to tritium. Because of the relative importance of the releases of tritium from SRS facilities through the groundwater to the environment, periodic evaluation and documentation of the facility operational status, proposed corrective actions, and projected changes/reductions in tritium releases are justified. Past, current, and projected tritium releases from the F and H Area Seepage Basins and the Solid Waste Disposal Facilities (SWDF) to Fourmile Branch are described. Each section provides a brief operational history along with the current status and proposed corrective actions. A conceptual model and quantitative estimates of tritium release from the facilities into the groundwater and the environment are developed. Tritium releases from the F and H Area Seepage Basins are declining and will be further reduced by the implementation of a groundwater corrective action required by the Resource Conservation and Recovery Act (RCRA). Tritium releases from the SWDF have been relatively stable over the past 10 years. It is anticipated that SWDF tritium releases to Fourmile Branch will remain approximately at current levels for at least 10–20 years. Specific characterization activities are recommended to allow an improved projection of tritium flux and to assist in developing plans for plume mitigation. SRS and the South Carolina Department of Health and Environmental Control are developing groundwater corrective action plans for the SWDF. Portions of the SWDF are also regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). Reduction of tritium flux is one of the factors considered in the development of the RCRA/CERCLA groundwater corrective action. The final section of the document presents the sum of the projected tritium fluxes from these facilities to Fourmile Branch.

27468 (WSRC-TR–93-063) **F-Area Acid/Caustic Basin groundwater monitoring report: Fourth quarter 1992 and 1992 summary.** Westinghouse Savannah River Co., Aiken, SC (United States). Mar 1993. 68p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93015381. Source: OSTI; NTIS; GPO Dep.

During fourth quarter 1992, samples from the six FAC monitoring wells at the F-Area Acid/Caustic Basin were analyzed for indicator parameters, groundwater quality parameters, parameters indicating suitability as drinking water, and other constituents. Monitoring results that exceeded the final Primary Drinking Water Standards (PDWS) or the Savannah River Site (SRS) flagging criteria or turbidity standard during the quarter are the focus of this report. Gross alpha exceeded the final PDWS in downgradient well FAC 4. Iron exceeded the Flag 2 criterion in 5 of the 6 wells; a change in sampling procedure accounts for marked increases. Three samples were elevated for each of the following constituents: manganese, total organic carbon, and total organic halogens. Turbidity equaled or exceeded the SRS standard in wells FAC 7 and 8.

27469 (WSRC-TR–93-065) **K-Area Acid/Caustic Basin groundwater monitoring report: Fourth quarter 1992 and 1992 summary.** Westinghouse Savannah River Co., Aiken, SC (United States). Mar 1993. 62p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93013574. Source: OSTI; NTIS; INIS; GPO Dep.

During fourth quarter 1992, samples from the KAC monitoring wells at the K-Area Acid/Caustic Basin were analyzed for indicator parameters, groundwater quality parameters, parameters indicating suitability as drinking water, and other constituents. New wells KAC 8 and 9 also were sampled for GC/MS VOA (gas chromatograph/mass spectrometer volatile organic analyses). Monitoring results that exceeded the final Primary Drinking Water Standards (PDWS) or the Savannah River Site (SRS) flagging criteria or turbidity standard during the quarter are discussed in this report. Iron exceeded the Flag 2 criterion in wells KAC 6 and 7, and specific conductance exceeded the Flag 2 criterion in new well KAC 9. No samples exceeded the SRS turbidity standard.

27470 (WSRC-TR–93-129) **Results of the second quarter tritium survey of the F- and H-Area seeplines, September 1992.** Dixon, K.L.; Rogers, V.A. Westinghouse Savannah River Co., Aiken, SC (United States). Feb 1993. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93015380. Source: OSTI; NTIS; INIS; GPO Dep.

The Environmental Sciences Section (ESS) established a quarterly monitoring program of the Four Mile Creek seepline down gradient from the F- and H-Area seepage basins. The program surveys and tracks changes in tritium, specific conductivity, and pH for the seepline water. Measurements from the second quarter survey (September 1992) showed lower tritium and conductivity measurements and more natural pH values (pH 5–6) than measurements from previous studies. The results of the first two quarterly surveys suggest that infiltration of rainfall may be diluting and flushing the contaminants from the groundwater system. More measurements are needed to confirm these trends.

27471 (YJT–92-21) **Review of the sorption of radionuclides on the bedrock of Haestholmen and on construction and backfill materials of a final repository for reactor wastes.** Kulmala, S. (Helsinki Univ. (Finland). Dept. of Radiochemistry); Hakanen, M. Nuclear Waste Commission of Finnish Power Companies, Helsinki (Finland). Oct 1992. [86p.] Order Number DE93630630. Source: OSTI; NTIS; INIS.

Imatran Voima Oy (IVO) has plans to build a final repository for reactor wastes in the bedrock of the nuclear power plant site at

Haestholmen, Loviisa. This report summarizes the sorption studies of radionuclides in Finnish bedrock performed at the Department of Radiochemistry, University of Helsinki. The values of mass distribution ratios, K_d, and surface distribution ratios, K_a; of carbon, calsium, Zirconium, niobium, cobalt, nickel, strontium, cesium, uranium, plutonium, americium, thorium, chlorine, iodine and technetium are surveyed. Special attention is paid to the sorption data for construction and backfill materials of rector waste repository and the bedrock of Haestholmen. Safety assessment of a repository includes calculations of migration of the waste element in construction materials and backfill in the nearfield and in bedrock. Retardation by sorption of waste nuclides compared to groundwater flow is described by using distribution ratios between solid materials and water. (orig.).

27472 (YJT–92-29) **A review of the seismotectonics of Finland.** Saari, J. (Imatran Voima Oy, Vantaa (Finland)). Nuclear Waste Commission of Finnish Power Companies, Helsinki (Finland). Dec 1992. [80p.] Order Number DE93629308. Source: OSTI; NTIS; INIS.

Recent major improvements in our knowledge about seismicity, crustal structure, primary stress field and tectonics together with other extensive geophysical and geological investigations have provided a good basis for a review of the seismotectonic setting of Finland. Correlations have been found to be present for the seismicity in Finland with the seismotectonic zones inside the Baltic Shield and with the seismicity of the North Atlantic Ridge. The current stress field in the Fennoscandian Shield seems to be dominated by ridge push forces. This conclusion is based on earthquake focal mechanisms, in-situ stress measurements and geodetic information. The report discusses the possible block movements induced by future glaciation. Location of the seismotectonic zones, duration of the glaciation and the presence of locally anomalous shear stresses seem to relate to the distribution of the discovered post-glacial faults in Fennoscandia. Special attention is paid to local seismotectonics. Potential direct or indirect effects on underground openings are possible due to local earthquakes or the creep. The importance of slow deformation processes in the bedrock is emphasized. (orig.).

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27473 (AEA-EE–0137) **A survey of fish and shellfish radioactivity levels in Cumbrian near-shore waters (1990).** McKay, W.A.; Memmott, S.D. AEA Environment and Energy, Harwell (United Kingdom). Sep 1991. [32p.] Order Number DE93630666. Source: OSTI; NTIS (US Sales Only); INIS.

Fish (cod and plaice), crustacea, (crab and lobster), and molluscs (winkle) samples were collected from Cumbrian near-shore waters in 1990. The samples were analysed for total beta activity and a range of gamma and alpha emitters. In general, the radionuclide levels are lower than those measured in the previous 3 years of the study and the intake of radioactivity by all consumers should have reflected this. The dose estimated to have been incurred by the critical group of local seafood consumers near Sellafield in 1990, mainly due to winkle consumption, is less than 0.1 mSv and thus significantly below the limit of 1 mSv per year for long term radiation exposure recommended by the International Commission on Radiological Protection. (author).

27474 (BNL–48476) **Greenland Sea observations.** Gudmandsen, P. (Technical Univ. of Denmark, Lyngby (Denmark). Inst. of Electromagnetics); Mortensen, H.B.; Pedersen, L.T.; Skriver, H.; Minnett, P. Brookhaven National Lab., Upton, NY (United States). [1992]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-9211215–1: 1. ERS-1 symposium: space in the service of our environment, Cannes (France), Nov 1992). Order Number DE93009351. Source: OSTI; NTIS; GPO Dep.

ERS-1 SAR data have been acquired over the Greenland Sea and Fram Strait during two periods, the Ice Phase of three-day repeat cycle from January to March 1992 and a one-month period in the 35-day repeat cycle from 16 July to 15 August 1992. Most data became available by way of the Broadband Data Dissemination System, i.e. with a spatial resolution of about 100 m. With these data various algorithms have been tested to derive sea ice parameters such as ice extent, ice concentration and ice displacement. In the latter period data were collected to support the activities of a research vessel in the area mainly related to the large polynyas that form east and north of Greenland. The formation of polynyas could clearly be outlined but also other phenomena were observed related to the influence of wind streets and gravity waves associated with the atmospheric boundary layer. The data will have to be studied further including full-resolution data to substantiate the conclusions arrived at.

27475 (CONF-930160–15) **Removal of uranium by biosorption.** Faison, B.D. (Oak Ridge National Lab., TN (US)); Bonner, J.D.; Munroe, N.D.; Bloomingburg, G.F. Oak Ridge National Lab., TN (United States). [1993]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 2. semi-annual Office of Technology Development (OTD) information meeting; Houston, TX (United States); 26-28 Jan 1993. Order Number DE93015445. Source: OSTI; NTIS; INIS; GPO Dep.

The technology developed here will exploit the ability of microorganisms to remove dissolved metals from aqueous solutions. Microbial sorbents for uranium will be immobilized biosorbents will be deployed ex situ within flow-through reactors for the continuous or semicontinuous treatment of recovered wastewaters. The proposed technology will primarily be applied within a pump-and-treat process using immobilized biosorbents for the large-scale, long-term remediation of uranium-laden surface water or groundwater impoundments (environmental restoration). The technology may be equally useful as an "end-of-pipe" treatment of process effluents (waste management). Successful operation of this process will achieve immobilization of the targeted waste and accompanying volume reduction.

27476 (CONF-9304144–2) **Trace contaminant determination in fish scale by laser ablation technique.** Lee, I.; Coutant, C.C.; Arakawa, E.T. Oak Ridge National Lab., TN (United States). [1993]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 2. international conference on laser ablation; Knoxville, TN (United States); 19-22 Apr 1993. Order Number DE93015426. Source: OSTI; NTIS; GPO Dep.

Laser ablation on rings of fish scale has been used to analyze the historical accumulation of polychlorinated biphenyls (PCB) in striped bass in the Watts Bar Reservoir. Rings on a fish scale grow in a pattern that forms a record of the fish's chemical intake. In conjunction with the migration patterns of fish monitored by ecologists, relative PCB concentrations in the seasonal rings of fish scale can be used to study the PCB distribution in the reservoir. In this study, a tightly-focused laser beam from a XeCl excimer laser was used to ablate and ionize a small portion of a fish scale placed in a vacuum chamber. The ions were identified and quantified by a time-of-flight mass spectrometer. Studies of this type can provide valuable information for the Department of Energy's (DOE) off-site clean-up efforts as well as identifying the impacts of other sources to local aquatic populations.

27477 (CONF-930830–17) **Ocean uptake of carbon dioxide.** Peng, Tsung-Hung (Oak Ridge National Lab., TN (United States)); Takahashi, Taro. Oak Ridge National Lab., TN (United States). [1993]. 44p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From National conference and exposition on heat transfer; Atlanta, GA (United States); 8-11 Aug 1993. Order Number DE93012967. Source: OSTI; NTIS; INIS; GPO Dep.

Factors controlling the capacity of the ocean for taking up anthropogenic $C0^2$ include carbon chemistry, distribution of alkalinity, pCO^2 and total concentration of dissolved $C0^2$, sea-air pCO^2 difference, gas exchange rate across the sea-air interface, biological carbon pump, ocean water circulation and mixing, and dissolution of carbonate in deep sea sediments. A general review of these processes is given and models of ocean-atmosphere system based

on our understanding of these regulating processes axe used to estimate the magnitude of $C0^2$ uptake by the ocean. We conclude that the ocean can absorb up to 35% of the fossil fuel emission. Direct measurements show that 55% Of $C0^2$ from fossil fuel burning remains in the atmosphere. The remaining 10% is not accounted for by atmospheric increases and ocean uptake. In addition, it is estimated that an amount equivalent to 30% of recent annual fossil fuel emissions is released into the atmosphere as a result of deforestation and farming. To balance global carbon budget, a sizable carbon sink besides the ocean is needed. Storage of carbon in terrestrial biosphere as a result of $C0^2$ fertilization is a potential candidate for such missing carbon sinks.

27478 (DOE/ER/60353–T1) **Biological processes in the water column of the South Atlantic Bight: Phytoplankton response: Final progress report.** Verity, P.G.; Yoder, J.A. Skidaway Inst. of Oceanography, Savannah, GA (United States). 10 Mar 1992. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG09-85ER60353. Order Number DE93016257. Source: OSTI; NTIS; GPO Dep.

This study addressed shelf-wide processes and nearshore (coastal boundary zone) processes occurring in the southeastern. Coastal boundary zone (CBZ) US continental shelf dynamics involve studies of circulation and of biological and chemical transformations. Continental shelf processes affect the removal of material from the coastal boundary zone into areas where the material no longer interacts with or influences concentrations in the CBZ. The two arbitrarily separate components are, in fact, unified. The CBZ typically extends about 300 km alongshore and about 20 km offshore from its center off Savannah, Georgia, where most runoff occurs. The rates of biological and chemical transformations are controlled by proximity to the bottom and the amounts of fine suspended organic matter originating from rivers and salt marshes. Once material is removed from this zone, either by alongshelf or cross-shelf advection to regions where the materials are no longer in contact with the bottom, the suite of factors governing the rates of chemical and biological transformations changes. The determination of contrasting rates in these two environments was one of the central focus of the South Atlantic Bight program.

27479 (DOE/ER/60980–T1) **[CO_2 measurements along the WOCE P-16 and 19 sections in the south Pacific Ocean: A joint LDGO/WHOI program]: Final report.** Goyet, C. Woods Hole Oceanographic Institution, MA (United States). [1992]. 47p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-90ER60980. Order Number DE93015576. Source: OSTI; NTIS; GPO Dep.

With the support from the Department of Energy, we participated in the World Ocean Circulation Experiment (WOCE) cruises to document the spatial variation of the properties of the carbonate system over the world ocean. With the other members of the DOE $C0_2$ science team, we took advantage of the initial postponed ship schedule to initiate an intercomparison of total dissolved inorganic carbon measurement in seawater. This work has proven to be essential for the measurements performed at sea soon after. We participated in 2 cruises in the Equatorial Pacific Ocean along 150° W and 135° W. Surface seawater $C0_2$ partial pressure (pCO_2) measured along 150° W has been compared with earlier measurements made by Ray Weiss in 1979 along the same cruise track. The large variations of surface seawater pCO_2 (pCO_2^{sea}) on short spatial and temporal scale do not allow us to determine whether anthropogenic $C0_2$ modified $pC0_2^{sea}$ in this ocean area. In the laboratory we also investigated a different means of measuring total alkalinity by thermometry. In this highly variable ocean, several complementary approaches are now underway to detect the anthropogenic signal and predict future changes: Continual monitoring of the carbonate properties in the ocean; Modeling and remote sensing; and monitoring of atmospheric pCO_2 and pO_2. In this report, we summarize the results of the at-sea measurements of the parameters of the carbonate system in seawater on the WOCE cruises P16c and P17c, as well as the theoretical and experimental results of laboratory studies made to improve the measurement techniques.

27480 (DOE/ER/61013–T2) **Mechanisms controlling the production and transport of methane, carbon dioxide, and dissolved solutes within a boreal peatland: Progress report, July 15, 1992–July 14, 1993.** Siegel, D.I. Syracuse Univ., NY (United States). Dept. of Geology. 24 Jun 1993. 24p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-90ER61013. Order Number DE93017089. Source: OSTI; NTIS; GPO Dep.

The role of freshwater peatlands in the global methane cycle remains uncertain. Field measurements of methane emissions tend to be highly variable across a peatland and exhibit sharp seasonal fluctuations. The process of extrapolating these variable measurements to regional estimates is further complicated by rudimentary knowledge of the environmental controls can the production and emissions of methane from peat. The distribution of methanogenesis within the peat profile will strongly influence the response of methane emissions to potential climatic changes. During the summers of 1990 and 1991 we conducted a study on the mechanisms for the production, transport, and storage of methane within the Glacial Lake Agassiz peatland region as the regional climate shifted from extreme drought to a period of normal rainfall. This natural experiment provided unexpected insights on the linkages among climate, hydrology, and the methane cycle in large peat basins. This report presents project progress for period July 15, 1992–July 14, 1993.

27481 (DOE/ER/61422–1) **Controls on marine carbon fluxes via phytoplankton-mesoplankton interactions in continental shelf waters: Six month progress report.** Shapiro, L.; Sherr, B.F.; Sherr, E.B. Oregon State Univ., Corvallis, OR (United States). [1992]. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG06-92ER61422. Order Number DE93015059. Source: OSTI; NTIS; GPO Dep.

The project is an in-depth evaluation of the phytoplankton → phagotrophic protist trophic link. The principal goals of the first year are to develop methods for the second phase of the Ocean Margins Program: investigations in the field. Our project is focused on: impact of grazing by phagotrophic protists on phytoplankton; impact of grazing by phagotrophic protists on bacterioplankton; taxon-specific growth rates of phytoplankton in situ, as they are affected by phagotrophy rates.

27482 (DOE/ER/61423–1) **Controls on marine carbon fluxes via phytoplankton-mesoplankton interactions in continental shelf waters: Progress report, December 1992.** Shapiro, L.; Sherr, B.F.; Sherr, E.B. Oregon State Univ., Corvallis, OR (United States). Coll. of Oceanography. 1992. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG06-92ER61423. Order Number DE93015058. Source: OSTI; NTIS; GPO Dep.

The principal goals of our projects were to develop methods for the second phase of the Ocean Margins Program: investigations in the field. Our project is focused on: (1) Impact of grazing by phagotrophic protists on phytoplankton, particularly on phototrophic cells < 5 μm in size which are not effectively grazed by metazooplankton; the impact of grazing by phagotrophic protists on bacterioplankton; and the taxon-specific growth rates of phytoplankton in situ, as they are affected by phagotrophy rates.

27483 (DOE/ID/13042–8) **Geophysical logging studies in the Snake River Plain Aquifer at the Idaho National Engineering Laboratory: Wells 44, 45, and 46.** Morin, R.H. (Geological Survey, Denver, CO (United States)); Paillet, F.L.; Taylor, T.A.; Barrash, W. Geological Survey, Denver, CO (United States). 1993. 50p. Sponsored by USDOE, Washington, DC (United States); Department of the Interior, Washington, DC (United States). DOE Contract FG07-91ID13042. (USGS/WRI–92-4184). Order Number DE93012949. Source: OSTI; NTIS; INIS; GPO Dep.

A geophysical logging program was undertaken to vertically profile changes in the hydrology and hydrochemistry of the Snake River Plain aquifer underlies the Idaho National Engineering Laboratory (INEL). Field investigations were concentrated within an area west of the Idaho Chemical Processing Plant (ICPP) in three wells that penetrated the upper 190 feet of the aquifer. The logs obtained in these wells consisted of temperature, caliper, nuclear (neutron porosity and gamma-gama density), natural gamma, borehole televiewer, gamma spectral, and thermal flowmeter (with and without

pumping). The nuclear, caliper, and televiewer logs are used to delineate individual basalt flows or flow units and to recognize breaks between flows or flow units at interflow contact zones and sedimentary interbeds. The temperature logs and flowmeter measurements obtained under ambient hydraulic head conditions identified upward fluid-circulation patterns in the three wells. Gamma-spectral analyses performed at several depths in each well showed that the predominant source of gamma radiation in the formation at this site originates mainly from potassium (^{40}K). However, ^{137}Cesium was detected at 32 feet below land surface in well 45. An empirical investigation of the effect of source-receiver spacing on the response of the neutron-porosity logging tool was attempted in an effort to understand the conditions under which this tool might be applied to large-diameter boreholes in-unsaturated formations.

27484 (DOE/ID–22105) **Water-level data for selected wells on or near the Idaho National Engineering Laboratory, Idaho, 1983–1990.** Ott, D.S.; Edwards, D.D.; Bartholomay, R.C. Geological Survey, Idaho Falls, ID (United States). Nov 1992. 307p. Sponsored by Department of the Interior, Washington, DC (United States). (USGS-OFR–92-643). Order Number DE93012162. Source: OSTI; NTIS; INIS; Books and Open-File Reports Section, US Geological Survey, Box 25425, Federal Center, Denver, CO 80225; GPO Dep.

The US Geological Survey has collected water-level data from wells completed in the Snake River Plain aquifer at the Idaho National Engineering Laboratory in southeastern Idaho since 1949. Water-level data collected through 1982 are presented in previous reports. Water-level data collected from 1983 through 1990 from 137 wells are presented in this report.

27485 (DOE/NV/10845–16) **Groundwater chemistry at the Nevada Test Site: Data and preliminary interpretations.** Chapman, J.B.; Lyles, B.F. Nevada Univ., Reno, NV (United States). Water Resources Center. Mar 1993. 48p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC08-90NV10845. Order Number DE93017131. Source: OSTI; NTIS; GPO Dep.

The interpretation of chemical analyses of groundwater collected at and near the Nevada Test Site (NTS) has been vital in developing conceptual models of groundwater flow in the area. These conceptual models are tested using recent chemical data generated by the Desert Research Institute, as well as historic analyses from the US Geological Survey. A total of 81 wells are represented by analyses from 1957 to 1990, with generally excellent agreement between repeat samples from the same location. As identified by previous workers, three hydrochemical facies are represented by the samples: Ca-Mg-HCO_3 water in carbonate rocks or alluvium derived from carbonates, Na-K-HCO_3 water in volcanic rocks and alluvium derived from volcanic rocks, and a mixed fades found in many carbonate and alluvium water samples, and some volcanic waters. There is a general lack of lateral continuity in chemical characteristics along presumed flowpaths within each hydrologic unit (alluvium, carbonate, and volcanic). Though a lack of continuity between basins on the east side of the NTS was expected for water in alluvial and volcanic units due to the absence of interbasin flow, chemical differences observed within individual basins suggest a dominance of vertical over lateral flow. Groundwater in volcanic materials on the east side of Yucca and Frenchman Flats and on the west side of Pahute Mesa and Yucca Mountain has a nearly pure Na-K-HCO_3 signature that reflects contact with primarily volcanic material. Groundwater in volcanic units in the middle of the NTS and on the east side of Pahute Mesa contains a higher proportion of Ca, Mg, Cl, and SO_4 than the other volcanic waters and indicates the contribution of water from the upper carbonate aquifer and/or hydrothermally altered regions.

27486 (DOE/RL–92-12) **Sampling and analysis of 100 Area springs.** Westinghouse Hanford Co., Richland, WA (United States); USDOE Richland Field Office, WA (United States). Feb 1992. 109p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE93013032. Source: OSTI; NTIS; INIS; GPO Dep.

This report is submitted in fulfillment of Hanford Federal Facility Agreement and Consent Order Milestone M-30-01, submit a report to EPA and Ecology evaluating the impact to the Columbia River from contaminated springs and seeps as described in the operable unit work plans listed in M-30-03. Springs, seeps, sediments, and the Columbia River were sampled for chemical and radiological analyses during the period September 16 through October 21, 1991. A total of 26 locations were sampled. Results of these analyses show that radiological and nonradiological contaminants continue to enter the Columbia River from the retired reactor areas of the 100 Area via the springs. The primary contaminants in the springs are strontium-90, tritium, and chromium. These contaminants were detected in concentrations above drinking water standards. Analysis of total organic carbon were run on all water samples collected; there is no conclusive evidence that organic constituents are entering the river through the springs. Total organic carbon analyses were generally higher for the surface water than for the springs. The results of this study will be used to develop a focused, yet flexible, long-term spring sampling program. Analysis of Columbia River water samples collected at the Hanford Townsite (i.e., downstream of the reactor areas) did not detect any Hanford-specific contaminants.

27487 (DOE/RL–93-09) **Annual report for RCRA groundwater monitoring projects at Hanford Site Facilities for 1992.** USDOE Richland Field Office, WA (United States). Feb 1993. 494p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE93014038. Source: OSTI; NTIS; INIS; GPO Dep.

This report documents the annual evaluation of 19 Resource Conservation and Recovery Act of 1976 (RCRA) groundwater monitoring projects and 1 nonhazardous waste facility at the US Department of Energy (DOE) Hanford Site. This document complies with regulations found in the State of Washington Administrative Code (WAC) as follows: (1) Dangerous Waste Regulations, WAC 173-303 (Ecology 1991) for hazardous wastes, and (2) Minimum Functional Standards for Solid Waste Handling, WAC 173-304 (Ecology 1989) for nonhazardous wastes. This report is not intended to be a comprehensive presentation of Hanford Site hydrogeology. Further information on each of the facilities can be found in the references cited within. The report meets the federal requirements for Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities, 40 CFR 265 subpart F (EPA 1989a); and Criteria for Classification of Solid Waste Disposal Facilities and Practices, 40 CFR 257 (EPA 1990) for nonhazardous wastes. This annual report is based on analytical data received from the analytical laboratories between October 1991 and November 1992, with the exception of nitrate data which dates back to June 1991. The November 1992 cutoff date represents results from samples collected through September 30, 1992. This report summarizes information obtained for facilities from the October–December 1991 quarterly report through the July–September 1992 quarterly report (DOE-RL 1992a, DOE-RL 1992b, DOE-RL 1992c, and DOE-RL 1993). The groundwater sampling and laboratory reporting performance are presented in Appendix A.

27488 (ETDE-IT–93-173) **Determination of Cu, Ni, Zn, Co and Mn in sea water by chelation ion chromatography.** Caprioli, R.; Torcini, S. ENEA, Casaccia (Italy). 1992. 18p. (CONF-9209366–1: International chromatography symposium 1992, Linz (Austria), 21-24 Sep 1992). Order Number DE93799192. Source: OSTI; NTIS (US Sales Only).

Pre-concentration and determination of trace elements in sea water by Chelation Ion Chromatography (CIC) was studied. For the retention of metal ions (0.25-0.30 M), ammonium acetate (at pH 4.8-5.1) and macro-porous iminodiacetate chelating resin were used. This system (CIC) permits trace and ultra-trace determination of metals in a variety of complex matrices expecially those high in alkali and alkaline-earth metals. The detection limit ranges from 0.1 to 0.5 nanogram. Satisfactory results are obtained in the range, 0.05-0.5 ug/L, when 60 ml of sample are pre-concentrated. In this work, the analysis of Zn, Cu, Ni, Co, and Mn in the Venice lagoon area were studied. The results acquired by chelation ion chromatography were compared with those obtained using the preconcentration of metals with dithizone and APDC in chloroform and analyzed by graphite furnace AAS.

27489 (ETDE-IT–93-177) **Monitoring program for evaluation of pollution level of Italian harbour sediments: General description.** Caricchia, A.M.; Chiavarini, S.; Cremisini, C.; Morabito, R.; Brondi, A.; Vitali, M. ENEA, Casaccia (Italy); Rome Univ. (Italy). 1992. 15p. (CONF-9210194–11: International symposium on environmental contamination in Central and Eastern Europe, Budapest (Hungary), 12-16 Oct 1992). Order Number DE93799197. Source: OSTI; NTIS (US Sales Only); INIS.

As part of a water pollution monitoring campaign, 120 sediment cores were sampled in the main Italian harbour basins, obtaining a total of 360 samples (3 subsamples at different depths for each core). All the samples were analyzed for several parameters, including physical characteristics, microbiological contamination indices, inorganic pollutants, and 36 selected samples were analyzed for organic micropollutants as well. In particular, PCB, chlorinated pesticides, PAH (polycyclic aromatic hydrocarbons) and organo-tin compounds were considered. A general description of the whole project, as well as, a description of the sampling sites are reported.

27490 (GTK-YST–80) **Measurements of hydraulic conductivity in deep bedrock at Palmottu, Outokumpu, Pori and Ylivieska.** Ahonen, L. Geological Survey of Finland, Espoo (Finland). 1992. [42p.] (In Finnish). Order Number DE93629316. Source: OSTI; NTIS; INIS.

Hydraulic conductivity of the bedrock was studied using a double packer equipment fitting the small-diameter drillholes (46 mm). Test method was a slug test, in which the pressure of the test section is reduced by removing water from a tube connected to the test section and, subsequently, monitoring the recovery of the original pressure. In the work, methods of interpretation suitable for the test method are examined, and compared by means of graphical simulations. Their relevance in the case of measurements in fractured crystalline bedrock are discussed. In the method of Hvorslev, the recovery rate is assumed to be directly proportional to residual drawdown and to the hydraulic conductivity of the test section and, consequently, the effect of specific storage is neglected. In other methods of interpretations (e.g. 'Cooper'- method), assuming radial flow from porous aquifer, specific storage is taken into consideration. Different methods of interpretation lead to dissimilar theoretical responses on recovery vs. time graphics. Skin-effect and outer boundary effects also have an influence on the shape of recovery curve. There is no major differences in K-values obtained by different methods of interpretation. The study sites represent different lithological environments, comprising migmatitic gneisses with granitic interlayers (Palmottu); a complex association of serpentine, black schist, quartzite, dolomite and scram (Outokumpu); arkosic sandstone (Pori); and mafic/ultramafic intrusion (Ylivieska).

27491 (INIS-mf–12758, pp. 489-494) **Determination of dispersion coefficients in the River Plate.** Maggio, G.E. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina). Dept. de Aplicaciones Tecnologicas); Graino, J.G.; Kopp, U.I.; Tripoli, C.R. Asociacion Argentina de Tecnologia Nuclear, Buenos Aires (Argentina). 1987. [735p.] (In Spanish). (CONF-8711355–: 15. scientific meeting and 4th Latin American meeting and 1st sessions on nuclear power plants, San Carlos de Bariloche (Argentina), 2-6 Nov 1987). In *Proceedings of the fifteenth scientific meeting; fourth Latin American meeting; first sessions on nuclear power plants.* Order Number DE91003052. Source: OSTI; NTIS (US Sales Only); INIS.

The determination of dispersion coefficients of contaminants through a radioactive tracer was performed as a contribution to the development of a mathematical model for a zone of the River Plate, close to the effluent discharge. During March 1987, six operations of tracer (I-131) injection and follow-up were carried out. The injection was performed by breaking a bulb under water and the follow-up of the 'radioactive spot' was done by means of a boat. Once the 'radioactive spot' was located (approximately 2 hours after the injection) a series of transversal movements over it was effected, measuring the activity concentration by means of a submerged detector. At the same time the coordinates of each point were determined in order to draw a map of the activity distribution. This procedure was repeated for different spot positions. This set of data can be plotted on a map of the zone under study, so as to obtain a set of iso activity curves. However, these curves would be representative provided that corrections are made for the boat speed, the water speed and the half-life of radionuclide. From each set of iso activity curves, the variance and the increase of variance, as well as the dispersion coefficients, can be determined. This procedure was applied to each one of the six above mentioned operations. Presently, different values of dispersion coefficient are available for different river conditions. These values, together with other parameters, such as wind velocity, temperature, salinity, bacterial behaviour, etc., will allow the calibration of the mathematical model. (Author).

27492 (INIS-mf–13541, pp. 27) **Isotopic composition relationships between rainfall and runoff in rocky basin in an arid zone.** Dody, A. (Ben-Gurion Univ. of the Negev, Beersheba (Israel)); Adar, E.; Issar, A.; Yair, A. Israel Geological Society, Jerusalem (Israel). Mar 1993. [173p.] (CONF-9303169–: Israel Geological Society annual meeting, Arad (Israel), 15 Mar 1993). In *Israel Geological Society annual meeting, 1993.* Order Number DE93627928. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. RAIN/isotope ratio; RUNOFF/isotope ratio; ISRAEL; RAIN; RUNOFF

27493 (INIS-mf–13541, pp. 62) **The isotopic composition of sulphur in rainwater from the Negev desert.** Herut, B. (Hebrew Univ., Jerusalem (Israel)); Katz, A.; Starinsky, A.; Spiro, B. Israel Geological Society, Jerusalem (Israel). Mar 1993. [173p.] (CONF-9303169–: Israel Geological Society annual meeting, Arad (Israel), 15 Mar 1993). In *Israel Geological Society annual meeting, 1993.* Order Number DE93627928. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. RAIN WATER/sulfur 34; ISOTOPE RATIO; ISRAEL

27494 (INIS-mf–13541, pp. 130) **Temporal variation (during 1992) in the radon flux at the Enot Zuqim (Dead Sea) anomaly.** Steinitz, G. (Geological Survey of Israel, Jerusalem (Israel)); Lang, B.; Gilat, A.; Vulkan, U.; Zafir, H.; Assael, Y.; Yaffe, Y. Israel Geological Society, Jerusalem (Israel). Mar 1993. [173p.] (CONF-9303169–: Israel Geological Society annual meeting, Arad (Israel), 15 Mar 1993). In *Israel Geological Society annual meeting, 1993.* Order Number DE93627928. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. RADON/dead sea; GEOLOGY; RADON; VAPORS

27495 (IVL-B–1092) **The use of aquatic organisms as environmental indicators.** Steiner, E. Swedish Environmental Research Inst., Stockholm (Sweden). Feb 1993. 88p. (In Swedish). Order Number DE93500712. Source: OSTI; NTIS.

This report is based on literature from the period 1949-1991. It includes a review on the environmental requirements of different taxa (as phytoplankton, waterplants, zooplankton and bottom fauna). In the report possible structures and changes caused by acidification under oligotrophic and eutrophic conditions are described. Over the last decade the use of biological parameters in monitoring has grown in importance and is likely to increase even more in the future. Both environmental indicators (species with narrow requirements) and bioindicators (species used for semiquantitative determination of bioavailability of xenobiotics) are useful. The sensitivity of organisms for e.g. acidification, oxygen deficiency, metal and oil pollutants and nutrients varies. For instance Mayflies has proved very suitable as an indicator of acidification, while bottom fauna (mainly chironomids and oligochaetes) has showed useful for evaluating ecological effects caused by industrial effluents, oxygen deficiency and nutrients. Diatoms is another useful group of indicators, particularly for oligotrophic and eurotrophic conditions. (31 refs., 6 figs.).

27496 (IVL-B–1097) **Aquatic model ecosystems for studies of ecological effects of pollution.** Axelsson, B. Swedish Environmental Research Inst., Stockholm (Sweden). Feb 1993. 53 p.p. (In Swedish). Order Number DE93500715. Source: OSTI; NTIS.

This is a literature review dealing with experiments with aquatic model ecosystems and similar multi-species experiments undertaken during investigations of pollutants and their effects. Descriptions of techniques used in such experiments are summarized;

these techniques being, for example, whole-lake experiments, pelagic sacks, limno-corrals, tanks, pools, dams, streams, and laboratory scale systems. Conclusions reached in earlier reviews on model ecosystems are summarized. Among other things, the role of these systems in bridging the gap between field and laboratory studies is dealt with. (80 refs., 8 figs., 2 tabs.).

27497 (MAFF-FRTR–93) **Ituna: a model of the Solway Firth.** Gurbutt, P.A. Ministry of Agriculture, Fisheries and Food, Lowestoft (United Kingdom). Directorate of Fisheries Research. 1993. [13p.] Order Number DE93630667. Source: OSTI; NTIS (US Sales Only); INIS.

During a review of the U.K. Directorate of Fisheries Research modelling requirements, Falconer's two-dimensional tidal model was identified as being one which could be acquired relatively cheaply and adapted to examine the dispersion of radionuclides in estuaries, particularly those of the eastern Irish Sea. This report documents efforts to set up this model for the Solway Firth and to introduce a two-dimensional sediment transport code. Even though the work on the Solway has been suspended, because there are insufficient data to validate the model, the lessons learnt are worth recording for future use, and could be adapted for example, to the Ribble Estuary. The main body of the report is divided into four parts, namely those on the equations being solved, the discretisation of the equations in the computer program and the method of solution, and that giving some samples of the unvalidated results for the Solway. (author).

27498 (OEFZS–4657) **International Atomic Energy Agency co-ordinated research programme 'the safety assessment of near-surface radioactive waste disposal facilities (NSARS)'.** Rejlek, G. (Hauptabteilung Entsorgungstechnik, Bereich Umwelt- und Verfahrenstechnik, Forschungszentrum Seibersdorf, Seibersdorf (Austria)). Oesterreichisches Forschungszentrum Seibersdorf GmbH (Austria). Nov 1992. [23p.] Order Number DE93627956. Source: OSTI; NTIS (US Sales Only); INIS.

This is the contribution of the research program NSARS organized by IAEA. The computer code SASTO was used to simulate the NSARS test code Nr 1. Features of the model used are described. Chapters are on the release to the geosphere, the radionuclide transport models and the intrusion scenarios (house buildings, farming, farm residential).

27499 (ORNL/FTR–4188) **[Travel to Bermuda to participate in the North Atlantic Treaty Organization (NATO) advanced research workshop on biogeochemical ocean-atmosphere transfers]: Foreign trip report, January 26–31, 1992.** Peng, Tsung-Hung. Oak Ridge National Lab., TN (United States). 14 Feb 1992. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93011295. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The traveler attended the NATO Advanced Research Workshop and presented an invited lecture entitled "Limiting Nutrients and Interhemispheric Transport of Carbon through the Ocean." This workshop specifically addressed atmosphere-to-ocean and ocean-to- atmosphere fluxes of key elements and compounds important in determining global climate.

27500 (ORNL/FTR–4509) **Biological markers and indicators of marine ecosystem health: Foreign trip report, November 21–28, 1992.** Shugart, L.R. Oak Ridge National Lab., TN (United States). 16 Dec 1992. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93009785. Source: OSTI; NTIS (US Sales Only); GPO Dep.

In response to the growing need to assess biological responses to anthropogenically induced changes and to define environmental criteria that can be used to indicate the health of marine ecosystems, the Group of Experts on the Scientific Aspects of Marine Pollution (GESAMP) established Working Group 33 (WG-33) on Indicators of Marine Ecosystem Health. The U.N. Environmental Program (UNEP) convened the first meeting of WG-33 at its regional office in Geneva from November 23 through 27, 1992.

27501 (ORNL/M–2533) **Belted kingfishers as ecological monitors of contamination: A review.** Landrum, C.L. (North Texas Univ., Denton, TX (United States). Dept. of Biology); Ashwood, T.L.; Cox, D.K. Oak Ridge National Lab., TN (United States). Mar 1993. 24p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93008983. Source: OSTI; NTIS; INIS; GPO Dep.

Environmental Sciences Division Publication No. 4017.

Aquatic systems serve as transport pathways and reservoirs for most of the contaminants known to be present on the Oak Ridge Reservation (ORR). Organisms that live in aquatic systems accumulate some of these contaminants from their food and directly from the water or sediment. A wide array of terrestrial organisms feeds on aquatic organisms and may accumulate contaminants from aquatic prey. The belted kingfisher (Ceryle alcyon) is a piscivorous and territorial avian species that may be a suitable monitor of contaminant accumulation at specific sites on the ORR. A kingfisher collected on White Oak Lake in 1991 had a ^{137}Cs concentration of 568 pCi/g in muscle tissue, which exceeds levels found in any other waterfowl collected from the lake. An investigation into the efficacy of using the kingfisher as an ecological indicator of aquatic contaminants on the ORR was initiated in late August 1992. The primary objective of this study was to acquire information concerning the ecology of the kingfisher to determine how the species could be used within the framework of the Biological Monitoring and Abatement Program at Oak Ridge National Laboratory (ORNL). A second important objective of the study was to examine the possible somatic and reproductive effects of polychlorinated biphenyls (PCBs), Hg, and various radioactive contaminants on piscivorous birds by reviewing pollution ecology studies conducted on those species.

27502 (PNL–8653) **Mollusc survey of the Hanford Site, Benton and Franklin Counties, Washington.** Frest, T.J.; Johannes, E.J. Pacific Northwest Lab., Richland, WA (United States); Deixis Consultants, Seattle, WA (United States). May 1993. 22p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93014372. Source: OSTI; NTIS; GPO Dep.

Assessment of the beneficial uses of the Columbia River and surrounding land at Hanford is enhanced by knowing the distribution of the plants and animals that live there. Deixis Consultants conducted surveys to determine the distribution of land and freshwater molluscs (malacofauna) on the US Department of Energy's Hanford Site and surrounding areas for the Pacific Northwest Laboratory. The surveys were conducted in 1992. Five species of freshwater molluscs and six species of land snails were found at 21 localities on the Site. The malacofauna of the Site is sparse in comparison to that of other areas in Washington with roughly comparable substrate and climate. Most species found at Hanford are widely distributed forms or are introduced (nonnative) taxa. The Site does have a single endemic land snail, Cryptomastix n. sp., found at a single location. This species likely will be considered a candidate for federal listing. Geologic factors and human modification of spring habitats are the likely causes for the depauperate malacofauna.

27503 (PNL–8656) **Subtidal eelgrass/macroalgae surveys for the proposed breakwaters at the US Coast Guard Station at Ediz Hook, Washington, March 1993.** Shreffler, D.K. (Battelle/Marine Sciences Lab., Sequim, WA (US)). Pacific Northwest Lab., Richland, WA (United States). May 1993. 42p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93016831. Source: OSTI; NTIS; GPO Dep.

In 1993, the US Coast Guard proposed to construct two breakwaters and a debris boom to protect its existing pier and moored vessels inside Ediz Hook in Port Angeles Harbor, Washington. To assist the US Army Corps of Engineers – Seattle District in determining the potential environmental impacts of the proposed breakwaters, Battelle/Marine Sciences Laboratory performed subtidal SCUBA surveys as specified in the Washington Department of Fisheries intermediate eelgrass/macroalgae habitat survey guidelines. The objectives of the subtidal surveys were to (1) quantify the shoot densities of eelgrass; (2) provide percent cover estimates for non-eelgrass macroalgae species; (3) develop a site map indicating the qualitative distribution of eelgrass/macroalgae species,

substrate characterization, approximate depth contours, and the approximate location of the proposed project features; and (4) document the time and date of the surveys, turbidity/visibility, presence of invertebrate/vertebrate species, and anecdotal observations pertinent to habitat characterization of the project site. A total of 14 dives along 12 transects (T1–T12) were successfully completed between March 15 and March 17, 1993. Eelgrass was observed on all of the transects except T7 and T8 at the western debris barrier and T12 along the waterward margin of the existing T-pier. The vicinity of the proposed east breakwater had the highest eelgrass shoot densities (up to 89 shoots/m^2) observed by the divers. Macroalgae and invertebrate species diversity were also highest at the east breakwater site. The low eelgrass densities observed at the west debris barrier site (0 to 14 shoots/m^2) can be attributed mostly to the lack of suitable substrate. The existing layer of wood debris armoring the bottom at the west project site currently limits, and in the areas of heaviest deposition probably precludes, the growth of eelgrass. As was expected, no eelgrass was observed at the south breakwater site.

27504 (PNL-SA–22329) **Diversity and richness of benthic insects in three cold desert spring-streams.** Gaines, W.L. (Pacific Northwest Lab., Richland, WA (United States)); Cushing, C.E. Pacific Northwest Lab., Richland, WA (United States); Washington Univ., Seattle, WA (United States). May 1993. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830 ;AM06-70RL02225. (CONF-9305237–1: Annual meeting of the North American Benthol Society, Calgary (Canada), 25-28 May 1993). Order Number DE93016159. Source: OSTI; NTIS; GPO Dep.

The authors examined species diversity and richness in three cold desert spring-streams, and showed that species diversity was similar and species richness was lower than in similar-size streams from other and or semi-arid regions. Species diversity in the spring-streams increased with increasing stream size and substratum diversity, but declined as distance increased from the nearest large source. However, this latter relationship is difficult to quantify because the nearest large source was the Columbia River, or one of its reservoirs, that has environmental conditions very different from those found in the study streams. It is more likely that the main source of colonizers for the spring-streams studied were other nearby small springs that could provide sources or stepping stone habitats for colonizers. Species diversity declined after winter spates, and the low species diversity and richness values appear to be greatly influenced by these events.

27505 (PNL-SA–22622) **Valuing the salmon resource: Columbia River stocks under climate change and fishery enhancement.** Anderson, D.M.; Scott, M.J. Pacific Northwest Lab., Richland, WA (United States). Apr 1993. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-9304161–1: Northwest Regional Economic conference, Kennewick, WA (United States), 30 Apr 1993). Order Number DE93016160. Source: OSTI; NTIS; GPO Dep.

This paper represents an update to ongoing multidisciplinary research in the area of climate change and associated regional impacts to fisheries and economies. This work particularly deals with the total value of Columbia River salmon and the idea that fish have capital value, articulated here as spawning value. Earlier work dealt solely with the Yakima River spring chinook fishery's response to climate change and fishery enhancement programs and the associated direct economic effects (Anderson et al. 1992). We have expanded our modeling attempts to examine similar impacts in the Grande Ronde River subbasin of the Columbia River basin, and added the summer steelhead stock to the analysis. Relatively recent developments and improvements in climate change modeling and fishery modeling enabled us to attempt such an endeavor.

27506 (RFP–4677) **Application of two real-time toxicity tests to monitor Rocky Flats Plant water quality.** Wolaver, H.; Spence, S.; Paton, I. EG and G Rocky Flats, Inc., Golden, CO (United States). Rocky Flats Plant. [1993]. 26p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC34-90DP62349. (CONF-9305184–1: 48. annual industrial waste conference, West Lafayette, IN (United States), 10-12 May 1993). Order Number DE93012699. Source: OSTI; NTIS; INIS; GPO Dep.

Rocky Flats Plant (RFP) is part of the Department of Energy (DOE) nuclear weapons complex and fabricated weapon components for the DOE from 1952 to 1989. Like other industrial facilities, RFP is subject to Clean Water Act (CWA) regulations that require surface water discharge monitoring. Unlike most industrial facilities, RFP is also regulated under a Federal Facility Compliance Agreement (FFCA) that requires development of water quality monitoring on a real-time basis. A surface water toxicity monitoring program was initiated in May 1991 to address requirements concerning prevention of toxic effluent discharges. The goal of the program is to determine which methods will provide real-time monitoring, thereby enhancing water management and protection of the aquatic environment downstream. In addition to the traditional whole effluent toxicity (WET) testing required by the FFCA, two other biological instrumentation techniques that may be applicable to real-time monitoring are being implemented. These are the Microtox™ (Microtox™ is a registered trademark of Microbics Corporation, hereinafter referred to as "Microtox") and automated respirometry. Both methods provide frequent sampling compared to WET testing and allow for more timely and frequent water quality measurement.

27507 (SR/H–539) **[Miscellaneous DP Material]: Savannah River biological survey, South Carolina and Georgia, June 1951–May 1952: Final report.** [DP Documents]. Academy of Natural Sciences of Philadelphia, PA (United States). Dept. of Limnology. Feb 1953. 321p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. Order Number DE93013440. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The Limnology Department of the Academy of Natural Sciences of Philadelphia made a study of the aquatic life of the Savannah River in the vicinity of the Savnnnah River Plant of the Atomic Energy Commission at the request of E.I. du Pont de Nemours & Company. The purpose of this survey was to establish an objective measure of the aquatic life of the river between Mile 134-175 and of Upper Three Runs so that any significant effect of the industrial or sanitary wastes could be determined in the future. The study was made in 1951–52, and consisted of a summer, a fall, a winter, and a spring survey. Each field team consisted of at least seven people: a chemist, an algologist, an entomologist, an ichthyologist, an invertebrate zoologist, a protozoologist, and a director and coordinator of the survey work. The chemical and bacteriological analyses, and the protozoological determinations were made in the field laboratory. Most of the other determinations were made in the Academy laboratories in Philadelphia. During each of these surveys, four regions on the Savannah River and one region on Upper Three Runs, a small tributary, were studied intensively. This report details the various aspects of the survey.

27508 (UCRL-JC–112367) **Uncertainty estimates in global ocean surface heat fluxes.** Gleckler, P.J. Lawrence Livermore National Lab., CA (United States). Nov 1992. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9210334–2: 17. annual climate diagnostics conference, Norman, OK (United States), 19-23 Oct 1992). Order Number DE93014126. Source: OSTI; NTIS; GPO Dep.

To date the only practical means of estimating large scale ocean surface heat fluxes is with bulk parameterization formulae. It is well known that there are many sources of uncertainties in such estimates due to sampling deficiencies, uncertainties in the field measurements and uncertainties in the parameterizations themselves. This report presents global estimates of the total uncertainties in the climatological annual mean net shortwave (SW), net longwave (LW), latent heat (LH) and sensible heat (SH) ocean surface heat fluxes. The flux estimates used here were compiled by Oberhuber (1988), which utilize the Monthly Summed Trimmed COADS 1950–1979 data.

27509 (VF-UH–93-4) **Mercury content in fish from newly impounded reservoirs.** Frick, K. Vattenfall AB, Vaellingby (Sweden). Dec 1992. 52 p.p. (In Swedish). Order Number DE93500930. Source: OSTI; NTIS; INIS.

During the seventies elevated mercury content in fish was observed in newly created reservoirs although background levels were normal. The initial rise of reservoir mercury levels is probably caused by the dramatically increased amount of organic matter

originating from flooded top-soil and vegetation. Mercury is introduced in the food-chain by methylating bacteria that utilize the surplus of organic matter. This microbial methylation is probably also favoured by reductions in oxygen content and pH that accompanies the decomposition of organic material. It is difficult to make reliable estimates of the duration and maximum levels of the elevated mercury levels since the end result is affected by several biological and chemical processes in combination. Variations may occur on the basis of the type and amount of flooded organic and inorganic material, water chemistry, specific combination of fish and residence time of reservoir water. All available preventive and ameliorating measures are untried in reservoir water bodies, at least in large scale experiments. Vegetation and top-soil stripping could be efficient but also very costly. Liming is a possible method in cases of ongoing or expected acidification. Addition of selenium is a potentially powerful way of lowering the mercury content in fish and this method is well suited to neutral water bodies. Large reductions in fish mercury content have been documented, but since selenium also has been shown to have strong negative effects on biota this method is not yet recommended. (57 refs.).

27510 (VF-UM–93-5) **Chemical modelling of trace elements in pore water from PFBC residues containing ammonia.** Karlsson, L.G. (Kemakta Consultants Co, Stockholm (Sweden)); Brandberg, F. Vattenfall AB, Vaellingby (Sweden). Jan 1993. 33p. Order Number DE93500924. Source: OSTI; NTIS; INIS.

Ammonia is added to the PFBC process with the purpose to reduce the emissions of NO_x in the stack gases. The design of the system for cleaning the stack gases will lead to an increased adsorption of ammonia and an accumulation of soluble ammonium salts in the cyclone ash from PFBC processes. This can be an environmental problem since the amounts will increase over the coming years and there will be a need to dispose the residues. When infiltrating rainwater penetrates the disposed residues ammonia and ammonium salts result in a contamination of the pore water with ammonia in the disposed residues. This entail the solubility of several trace elements in the residues that form soluble complexes with ammonia will increase and cause an increased contamination of groundwater and surface water. In this study the increased solubilities is calculated for the trace elements cadmium, cobalt, copper, mercury, nickel, silver and zinc in the residues using thermodynamical data. The calculations have been performed with probable solid phases of the trace elements at oxidizing and reducing conditions as a function of pH and at varying concentration of ammonia in the pore water. The thermodynamic calculations have been performed with the geochemical code EQ3NR. The results from the calculations show that as a concentration of 17 mg NH_3/l in the pore water of the residues increases the solubilities for copper and silver. If the concentration of ammonia increases to 170 mg NH_3/l will the solubilities increase also for cadmium, nickel and zinc. (12 refs., 39 figs.).

27511 (YJT–92-23) **Saline groundwater in crystalline bedrock: A literature survey.** Lampen, P. (Ekono Energy Ltd., Espoo (Finland)). Nuclear Waste Commission of Finnish Power Companies, Helsinki (Finland). Nov 1992. [96p.] Order Number DE93629317. Source: OSTI; NTIS; INIS.

The State-of-art report describes research made on deep saline groundwaters and brines found in crystalline bedrock, mainly in site studies for nuclear waste disposal. The occurrence, definitions and classifications of saline groundwaters are reviewed with a special emphasis on the different theories concerning the origins of saline groundwaters. Studies of the saline groundwaters in Finland and Sweden have been reviewed more thoroughly. Also the mixing of different bodies of groundwaters, observations of the contact of saline groundwaters and permafrost, and the geochemical modelling of saline groundwaters as well as the future trends of research have been discussed. (orig.).

27512 (YJT–92-30) **Modelling of water-rock interaction at TVO investigation sites: Summary report.** Pitkaenen, P. (Technical Research Centre of Finland, Espoo (Finland). Road, Traffic and Geotechnical Lab.); Snellman, M.; Leino-Forsman, H. Nuclear Waste Commission of Finnish Power Companies, Helsinki (Finland). Dec 1992. [101p.] Order Number DE93630668. Source: OSTI; NTIS; INIS.

The geochemistry of the groundwater at the Kivetty, Syyry and Olkiluoto site investigation areas in Finland for nuclear waste disposal is evaluated. The hydrogeological data is collected from boreholes drilled down to 100-m depth into crystalline bedrock. The interpretation is based on groundwater chemistry and isotope data, mineralogical data, and the structure and hydrology of the bedrock, using correlation diagrams and the thermodynamic calculations (PHREEQE,EQ3NR). The hydrogeochemistry and major processes controlling the groundwater chemistry are discussed.

27513 (YJT–93-01) **TVO-Flowmeter.** Rouhiainen, P. (PRG-Tec Oy, Espoo (Finland)). Nuclear Waste Commission of Finnish Power Companies, Helsinki (Finland). Jan 1993. [40p.] Order Number DE93629318. Source: OSTI; NTIS; INIS.

TVO-flowmeter has been field tested in boreholes in the crystalline bedrock. It is possible to measure the groundwater flow both across and along a borehole. Sensitivity is better than 1 ml/h (milliliter per hour) for the flow across the hole. This corresponds the flux value (Darcy velocity) of about $2*10^{-9}$ m/s. The system makes it possible to determine roughly the direction of the flow across the hole. The boreholes in the bedrock change flow conditions. The effects of the borehole and flowmeter-borehole combination are studied by theoretical models. Field examples are presented from flows along and across the hole. The sensitivity of the instrument is demonstrated. Several repeated measurements are presented. Examples are shown of the variation of the flow with time.

55 BIOMEDICAL SCIENCES, BASIC STUDIES

Refer also to citation(s) 27390, 27503, 27504

5501 Behavioral Biology

Refer also to citation(s) 27533, 27653

27514 (DOE/SR/14069–5) **Establishment of a viable population of red-cockaded woodpeckers at the Savannah River Site: Annual report, FY1992.** Laves, K.S. (Forest Service, Aiken, SC (United States). Southeastern Forest Experiment Station). US-DOE Savannah River Operations Office, Aiken, SC (United States); Forest Service, Aiken, SC (United States). Southeastern Forest Experiment Station. 11 Sep 1992. 13p. Sponsored by USDOE, Washington, DC (United States); Department of Agriculture, Washington, DC (United States). DOE Contract AI09-85SR14069. Order Number DE93015422. Source: OSTI; NTIS; GPO Dep.

The Southeastern Forest Experiment Station (SEFES) began research on the red-cockaded woodpecker (RCW) on the Savannah River Site (SRS) in 1985 with the objective of restoring a viable population. This Project is conducted in cooperation with the Department of Energy, the Savannah River Forest Station (SRFS) and the Savannah River Ecology Laboratory. The program has consisted of two phases. The stabilization phase (1985–1987) focused on preventing the immediate extirpation of the RCW population. During this phase the number of breeding pairs of RCWs increased from one to three, and the total population increased from five to 14 birds. We are currently in the expansion phase (1987-present). To facilitate the population expansion of the RCW at SRS, SEFES and SRFS have implemented numerous research and management activities. These include: control of mid-story vegetation to improve habitat suitability, installation of artificial cavities for RCWS, translocations of RCWs within the SRS and from other populations, maintenance of cavities by installing metal restrictors to discourage cavity competition, and generic research to ascertain the degree of relatedness between individuals and populations.

5502 Biochemistry

Refer also to citation(s) 25621, 25942, 25952, 25961, 25981, 25997, 26522, 26853, 27519, 27631

27515 (DOE/ER/13709–5) **Phytochromes in photosynthetically competent plants: Final report.** Pratt, L.H. Georgia Univ.,

Athens, GA (United States). Dept. of Botany. [1991]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG09-87ER13709. Order Number DE93015938. Source: OSTI; NTIS; GPO Dep.

Major improvements have been made in the purification of green-oat phytochrome. An effective protease inhibitor has been incorporated, the scale of preparations has been increased greatly, an immunodominant contaminant has been eliminated, and the extent of purification has been increased by at least a factor of ten. Five new MAbs and rabbit PAbs to green-oat phytochrome, as well as rabbit PAbs to a synthetic, putative green-oat phytochrome peptide, have been produced and characterized, together with two MAbs to green-oat phytochrome that had been identified previously. Our earlier hypothesis that green-oat phytochrome itself consists of two types was found to be true. One type of green-oat phytochrome has an apparent monomer size of 125 kDa while the other is 123 kDa. The latter undergoes a Zn^{2+}-induced mobility shift during SDS PAGE and the two phytochromes are immunochemically distinct from one another. Affinity columns prepared with MAbs to green-oat phytochrome have been used to purify 125-kDa green-oat phytochrome to near homogeneity. A proteolytically derived peptide has been isolated from immunopurified green-oat phytochrome and 19 residues have been determined by microsequencing. The results verify that in monocotyledons as well as dicotyledons green- and etiolated-oat phytochromes derive from different genes.

27516 (DOE/ER/20041–1) **Structure and regulation of an archaebacterial promoter: An in vivo study: Progress report, August 1, 1991–March 31, 1993.** Daniels, C.J. Ohio State Univ., Columbus, OH (United States). Dept. of Microbiology. 1993. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-91ER20041. Order Number DE93015782. Source: OSTI; NTIS; GPO Dep.

We have established that a 100 bp DNA fragment from the Haloferax volcanii tRNALys gene directs transcription in vivo. This element served as the starting point for a detailed analysis of the requirements for in vivo transcription. Among several gene tentatively identified as reporter elements, we selected a eukaryotic intron-containing tRNAPro gene for when it is driven by the H. volcanii tRNALys promoter fragment, produces a single small transcript. Transcript analysis, by SI mapping and primer extension, showed that this RNA initiated at the expected tRNALys BoxB sequence and terminated in the tRNAPro RNA Pol III termination element present on the DNA fragment. In initial studies we determined that the 3 inches proximal region of this tRNALys promoter element was sufficient for transcription initiation in vivo. This 40 bp region contains only the BoxA and BoxB regions and short purine rich regions 5 inches to the BoxA and BoxB sequence. Using the tRNAPro gene as the reporter and this minimal promoter, we performed a comprehensive analysis of the BoxA region. Each position of the BoxA region was converted to an four possible nucleotides and the transcription of 36 mutants was quantitated. Among the sites analyzed, only five of the positions showed high levels of discrimination; the preferred BoxA element was 5 inches-$TT(_T/A)(^A/T)$ ANNNN-3 inches. Mutational analysis demonstrated that a transition from T-rich to A-rich sequences in the BoxA element is essential and that there is some flexibility in the location of the "TA" sequence. Additionally the TA sequence appears to determine the location of the transcription start site. The BoxA element defined in this study is similar to those observed for Sulfolobus and the methanogen promoters, and supports the hypothesis that a similar core promoter element is used by all archaeal RNA polymerases.

27517 (DOE/ER/61040–2) **Characterization of the mammalian DNA polymerase gene and protein: Annual progress report.** Mishra, N.C. South Carolina Univ., Columbia, SC (United States). Jan 1992. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG09-90ER61040. Order Number DE93017270. Source: OSTI; NTIS; GPO Dep.

We have purified and characterized at least three DNA polymerases from Chinese hamster ovary (CHO) cell line KI in order to evaluate the roles of different polymerases in eukaryotic DNA replication. Pol α was the most abundant among different polymerase activities and it was neutralized by a monoclonal antibody raised against human pol α. Pol ε was separated from pol α and pol δ activities using DEAE Sephacell, phosphocellulose and hydroxylapatite columns. The enzyme proved to be sensitive to aphidicolin and carbonyldiphosphonate and was not stimulated by PCNA- Pol δ was the least abundant among the three enzymes. It was sensitive to aphidicolin and carbonyidiphosphonate and was stimulated by PCNA. it had a preference for template/primer poly (dA-dT). Based on DNA sequence data of different eukaryotic polymerases PCR primers complementary to two neighboring synthesized. In PCR experiments several products were obtained which are assumed to be specific for the CHO polymerases. We have also analyzed a large number of aphidicolin resistant mutants of CHO to identify mutants with altered DNA polymerases.

27518 (ORNL/FTR–4175) **[Travel to Japan for collaborative research on DNA repair]: Foreign trip report, September 17–December 30, 1991.** Mitra, S. Oak Ridge National Lab., TN (United States). 8 Jan 1992. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93011055. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The traveler was awarded a 3-month Fellowship by the Japan Society for the Promotion of Science for carrying out collaborative research on DNA repair with Prof. M. Ikenaga at the Kyoto University Radiation Biology Center and for visiting several other laboratories with similar research interests. The traveler was appointed as a Visiting Professor in Kyoto University and spent most of his time at the Radiation Biology Center. He supervised T. Kato, a Ph.D. student in Prof. Ikenaga's laboratory, in the cloning and characterization of mammalian genes for DNA repair. He also visited several leading laboratories for DNA repair and mutagenesis studies in Japan. He was invited to give a special lecture at the t Annual Meeting of the Japan Radiation Research Society and was one of five speakers in a symposium marking the anniversary of the Radiation Biology Center and the Department of Experimental Radiology at Kyoto University Medical School. During his stay in Kyoto he made a short trip to Seoul, S. Korea, for delivering a lecture in a special symposium of the Korean Society of Molecular Biology. The overall impression of the traveler is that the molecular biology research in Japan is outstanding in most of the laboratories visited by him. This is perhaps expected. However, the organizational approach of research laboratories is very different from that practiced in the US laboratories. The Japanese laboratories routinely generate very elegant work, but the leading US laboratories appear to be superior in innovative research.

5504 Genetics

Refer also to citation(s) 27516, 27541

27519 (DOE/ER/60984–3) **Gene sequencing by scanning molecular excitation microscopy: Progress report, June 1990–June 1993.** Kopelman, R. Michigan Univ., Ann Arbor, MI (United States). [1993]. 24p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-90ER60984. Order Number DE93017053. Source: OSTI; NTIS; GPO Dep.

We propose to complete the development of scanning molecular excitation microscopy to rapidly sequence DNA. This new type of scanned-tip microscopy is specifically designed to map individual DNA bases in a non-destructive fashion. Base recognition is based on the external heavy atom effect between a heavy atom label on a specific DNA base and a fluorescent sensor molecule at the end of a scanned optical tip. As the tip is scanned very close to the heavy atom its emissions will change intensity and wavelength. For sequencing, heavy-atom labeled single-stranded DNA molecules will be synthesized and oriented on a flat substrate such as mica. An optical tag an one end of each DNA molecule will be rapidly located at low resolution using conventional fluorescence or scanning near-field optical microscopy. Scanning with the same optical tip, the low-resolution path of the DNA will be mapped using long-range interactions such as attractive van der Waals forces or Forester energy transfer. Subsequently, the labeled bases will be mapped at better than 5Å resolution with the same tip using the external heavy atom effect, and the coordinates stored and processed by computer. The proposed microscope could be automated to quickly sequence intact lambda clones, YACK, or genomic Not I fragments, making genomic sequencing much more rapid and economical.

27520 (LA-UR–92-2620) **Los Alamos Science: The Human Genome Project: Number 20, 1992.** Cooper, N.G.; Shea, N. (eds.). Los Alamos National Lab., NM (United States). 1992. 345p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93014410. Source: OSTI; NTIS; GPO Dep.

This article provides a broad overview of the Human Genome Project, with particular emphasis on work being done at Los Alamos. It tries to emphasize the scientific aspects of the project, compared to the more speculative information presented in the popular press. There is a brief introduction to modern genetics, including a review of classic work. There is a broad overview of the Genome Project, describing what the project is, what are some of its major five-year goals, what are major technological challenges ahead of the project, and what can the field of biology, as well as society expect to see as benefits from this project. Specific results on the efforts directed at mapping chromosomes 16 and 5 are discussed. A brief introduction to DNA libraries is presented, bearing in mind that Los Alamos has housed such libraries for many years prior to the Genome Project. Information on efforts to do applied computational work related to the project are discussed, as well as experimental efforts to do rapid DNA sequencing by means of single-molecule detection using applied spectroscopic methods. The article introduces the Los Alamos staff which are working on the Genome Project, and concludes with brief discussions on ethical, legal, and social implications of this work; a brief glimpse of genetics as it may be practiced in the next century; and a glossary of relevant terms.

5505 Metabolism

Refer also to citation(s) 25525, 25532, 27532

5506 Medicine

Refer also to citation(s) 26881, 27602

27521 (BNL–48561) **Summing up: The physics of NCT.** Brugger, R.M. Brookhaven National Lab., Upton, NY (United States). [1993]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-9309122–1: 5. international symposium on neutron capture therapy, Columbus, OH (United States), 12-17 Sep 1993). Order Number DE93010867. Source: OSTI; NTIS; INIS; GPO Dep.

Neutron Capture Therapy (NCT) is a binary system for treating tumors in which both an agent, usually B-10, and thermal neutrons are directed to a tumor where they combine and release lethal radiation. Directing the agent to the tumor is mainly a chemistry and biology problem, while the production, targeting and effects of the neutrons is mainly a physics problem. This paper briefly describes the, physics side of NCT as presented at this symposium, the neutron beams, the dosimetry and treatment planning, and the element identification. The development of the physical tools and methods are not now limiting the successful demonstration of NCT. Several epithermal neutron beams are available, dosimetry methods are in hand, and treatment planning methods can be ready when required. Methods of identifying elements have been demonstrated, but are not yet widely accessible. New methods could supply valuable additional information about the quantity and location of NCT elements, particularly on the microscopic scale and in vivo.

27522 (DOE/ER/60972–3) **Synthesis and evaluation of boron compounds for neutron capture therapy of malignant brain tumors: Technical progress report No. 1, May 1, 1990–January 31, 1991.** Soloway, A.H.; Barth, R.F. Ohio State Univ. Research Foundation, Columbus, OH (United States). [1990]. 21p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-90ER60972. Order Number DE93015880. Source: OSTI; NTIS; GPO Dep.

Boron neutron capture therapy offers the potentiality for treating brain tumors currently resistant to treatment. The success of this form of therapy is directly dependent upon the delivery of sufficient numbers of thermal-neutrons to tumor cells which possess high concentrations of B-10. The objective of this project is to develop chemical methodology to synthesize boron-containing compounds with the potential for becoming incorporated into rapidly-dividing malignant brain tumor cells and excluded from normal components of the brain and surrounding tissues, to develope biological methods for assessing the potential of the compound by use of cell culture or intratumoral injection, to develop analytical methodology for measuring boron in cells and tissue using direct current plasma atomic emission spectroscopy (DCP-AES) and alpha track autoradiography, to develop biochemical and HPLC procedures for evaluating compound uptake and tissue half-life, and to develop procedures required to assess both in vitro and vivo efficacy of BNCT with selected compounds.

27523 (EGG-BNCT–10119) **A benchmark analysis of radiation flux distribution for Boron Neutron Capture Therapy of canine brain tumors.** Moran, J.M. EG and G Idaho, Inc., Idaho Falls, ID (United States). Feb 1992. 376p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. Order Number DE93013698. Source: OSTI; NTIS; INIS; GPO Dep.

Calculations of radiation flux and dose distributions for Boron Neutron Capture Therapy (BNCT) of brain tumors are typically performed using sophisticated three-dimensional analytical models based on either a homogeneous approximation or a simplified few-region approximation to the actual highly-heterogeneous geometry of the irradiation volume. Such models should be validated by comparison with calculations using detailed models in which all significant macroscopic tissue heterogeneities and geometric structures are explicitly represented as faithfully as possible. This work describes a validation exercise for BNCT of canine brain tumors. Geometric measurements of the canine anatomical structures of interest for this work were performed by dissecting and examining two essentially identical Labrador Retriever heads. Chemical analyses of various tissue samples taken during the dissections were conducted to obtain measurements of elemental compositions for tissues of interest. The resulting geometry and tissue composition data were then used to construct a detailed heterogeneous calculational model of the Labrador Retriever head. Calculations of three-dimensional radiation flux distributions pertinent to BNCT were performed for the model using the TORT discrete-ordinates radiation transport code. The calculations were repeated for a corresponding volume-weighted homogeneous tissue model. Comparison of the results showed that the peak neutron and photon flux magnitudes were quite similar for the two models (within 5%), but that the spatial flux profiles were shifted in the heterogeneous model such that the fluxes in some locations away from the peak differed from the corresponding fluxes in the homogeneous model by as much as 10-20%. Differences of this magnitude can be therapeutically significant, emphasizing the need for proper validation of simplified treatment planning models.

27524 (ETDE-IT–93-157) **Combined radiation and hyperthermia: Effects of number of heat fractions and their interval on normal and tumor tissues.** Marino, C.; Cividalli, A. ENEA, Casaccia (Italy). 1992. 25p. Order Number DE93799228. Source: OSTI; NTIS (US Sales Only); INIS.

The effect of one or more heat treatments at 43 degrees C combined with conventional multi-fraction irradiation was studied in murine normal and tumoral tissues in mice. The endpoint of this study was the TCD50 of the C3H mammary carcinoma, inoculated into the foot. For normal tissue, the reaction of the skin of the foot was assessed according to a graded scoring system. Twenty X-ray fractions delivered in 20 or 26 days were combined with 1, 4 or 8 fractions of quasi-simultaneous or sequential hyperthermia (i.e., heat applied 4 hrs after irradiation). The tumor dose response curves show a decrease in TCD50 and in increase in TER linked to the increasing number of heat sessions. A qualitatively similar effect of the number of sessions was observed for the different protocols (quasi-simultaneous and sequential) and for the two overall times. No significant difference was measured between 1 and 4 HT sessions plus 20 fx of RT in the normal tissue damage, while a slight difference was observed between 1, 4 and 8 HT sessions delivered with 20 fractions of RT in 26 days.

27525 (LBL–29628) **Electronic schematics for the Donner 600 Crystal Tomograph.** Huesman, R.H.; Derenzo, S.E.; Moses, W.W.; Cahoon, J.L.; Geyer, A.B.; Turko, B.T.; Uber, D.C.; Colina, M.; Ho, M.H.; Budinger, T.F. Lawrence Berkeley Lab., CA (United

States). Sep 1992. 58p. Sponsored by USDOE, Washington, DC (United States); Public Health Service, Washington, DC (United States). DOE Contract AC03-76SF00098. Grant P01 HL25840. Order Number DE93015277. Source: OSTI; NTIS; GPO Dep.

This report provides a collection of electronic schematics detailing the lay out and wiring of the Donner 600 Crystal Tomograph.

27526 (LBL–32641-Rev.1) **Interfacing US Census map files with statistical graphics software: Application and use in epidemiology: Revision 1.** Rizzardi, M. (Lawrence Berkeley Lab., CA (United States)); Mohr, M.S.; Merrill, D.W.; Selvin, S. Lawrence Berkeley Lab., CA (United States). Mar 1993. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-9207201–1-Rev.1: Statistics and computing in disease clustering, Stony Brook, NY (United States), 23-24 Jul 1992). Order Number DE93013911. Source: OSTI; NTIS; GPO Dep.

In 1990, the United States Bureau of the Census released detailed geographic map files known as TIGER/Line (Topologically Integrated Geographic Encoding and Referencing). The TIGER files, accessible through purchase or Federal repository libraries, contain 24 billion characters of data describing various geographic features including coastlines, hydrography, transportation networks, political boundaries, etc. covering the entire United States. Many of these physical features are of potential interest in epidemiological case studies. Unfortunately, the TIGER database only provides raw alphanumeric data; no utility software, graphical or otherwise, is included. Recently, the S statistical software package has been extended to include a map display function. The map function augments S's high-level approach toward statistical analysis and graphical display of data. Coupling this statistical software with the map database developed for US Census data collection will facilitate epidemiological research. We discuss the technical background necessary to utilize the TIGER database for mapping with S. Two types of S maps, segment-based and polygon-based, are discussed along with methods to construct them from TIGER data. Polygon-based maps are useful for displaying regional statistical data; e.g., disease rates or incidence at the census tract level. Segment-based maps are easier to assemble and appropriate if the data are not regionalized. Census tract data of AIDS incidence in San Francisco (CA) and lung cancer case locations relative to petrochemical refinery sites in Contra Costa County (CA) are used to illustrate the methods and potential uses of interfacing the TIGER database with S.

27527 (LBL–33749) **Performance specifications for proton medical facility.** Chu, W.T. (Lawrence Berkeley Lab., CA (United States)); Staples, J.W.; Ludewigt, B.A.; Renner, T.R.; Singh, R.P.; Nyman, M.A.; Collier, J.M.; Daftari, I.K.; Petti, P.L.; Alonso, J.R.; Kubo, H.; Verhey, L.J. Lawrence Berkeley Lab., CA (United States). Mar 1993. 127p. Sponsored by Department of Health and Human Services, Washington, DC (United States). DOE Contract AC03-76SF00098. Grant CA56932. Order Number DE93015375. Source: OSTI; NTIS; GPO Dep.

Performance specifications of technical components of a modern proton radiotherapy facility are presented. The technical items specified include: the accelerator; the beam transport system including rotating gantry; the treatment beamline systems including beam scattering, beam scanning, and dosimetric instrumentation; and an integrated treatment and accelerator control system. Also included are treatment ancillary facilities such as diagnostic tools, patient positioning and alignment devices, and treatment planning systems. The facility specified will accommodate beam scanning enabling the three-dimensional conformal therapy deliver.

27528 (ORNL/FTR–4271) **Travel to Germany to work on off-site assignment at the Clinic for Nuclear Medicine at the University of Bonn, Germany, for a one-year period through support as a Senior American Scientist of the Alexander von Humboldt Foundation of Germany: Foreign trip report, June 10, 1991–June 4, 1992.** Knapp, F.F. Jr. Oak Ridge National Lab., TN (United States). 19 Jun 1992. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93011101. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The traveler worked on off-site assignment at the Clinic for Nuclear Medicine at the University of Bonn, Germany, for a one-year period through support as a Senior American Scientist of the Alexander von Humboldt Foundation of Germany. He also attended and presented invited lectures at the XIIIth Congress of the European Society of Cardiology in Amsterdam, the Netherlands, the European Association of Nuclear Medicine Congress in Vienna, Austria, the Southeastern Chapter of the Society of Nuclear Medicine in Miami Beach, Florida, the International Congress on Neuroimaging in Psychiatry in London, England, the Second Mediterranean Symposium on Nuclear Medicine and Radiopharmaceuticals in Athens, Greece, and the ALASBIMN Nuclear Medicine Congress in Madrid, Spain.

27529 (ORNL/TM–12375, pp. 12-26) **A self-learning Bayesian Expert System.** Alemi, F. (Cleveland State Univ., OH (US)); Bhatt, P.; Eisenstein, E.; Fadlalla, A.; Stephens, R.; Butts, J. Oak Ridge National Lab., TN (United States). May 1993. (CONF-9306151–: 7. international symposium on methodologies for intelligent systems, Trondheim (Norway), 15-18 Jun 1993). In *Proceedings of the Seventh International Symposium on Methodologies for Intelligent Systems (Poster Session).* 174p. Order Number DE93013470. Source: OSTI; NTIS.

This paper presents a Bayesian Expert System (B.E.St.). This system is different from other forms of supervised machine learning in that it induces likelihood ratios from a set of cases. B.E.St. provides unique methods for managing conditional dependencies, for selecting questions to use in its models, and for predicting events when given responses that are not contained in its original set of cases. 29 refs., 3 figs., 3 tabs.

27530 (ORNL/TM–12375, pp. 44-54) **Competence-switching managed by intelligent systems.** Egger, E. (Technical University of Vienna (AT)); Hanappi, H. Oak Ridge National Lab., TN (United States). May 1993. (CONF-9306151–: 7. international symposium on methodologies for intelligent systems, Trondheim (Norway), 15-18 Jun 1993). In *Proceedings of the Seventh International Symposium on Methodologies for Intelligent Systems (Poster Session).* 174p. Order Number DE93013470. Source: OSTI; NTIS.

This article deals with problems of time-management and the coordination of activities of heterogeneous agents. To support the planning of strongly interwoven jobs more than a pure scheduling algorithm is needed: Since hierarchical power-relations, diverging objective functions and unequally distributed decision competencies prohibit any straight-forward solution, a more complex framework switching between computer support and face-to-face decisions is more adequate. The issues are discussed in the context of hospital organization, in particular for the example of surgery-planning. 16 refs., 4 figs.

27531 (SSI–92-02) **Sensitivity of screen-film systems.** Sandborg, M. (Lunds Lasarett (Sweden). Avd. f Sjukhusfysik); Nilsson, Goergen; Holje, G. Swedish Radiation Protection Inst., Stockholm (Sweden). Jan 1992. [17p.] (In Swedish). Order Number DE93630856. Source: OSTI; NTIS; INIS.

This report, which has been funded by SSI, presents sensitivity data on the 'second generation' of modern intensifying screens, commercially available at the onset of the investigation. The sensitivity of the screen-film systems was evaluated with 80 kV tube potential and a total filtration of 3.0 mm Al. 20 mm aluminum was used for simulating human tissue, since it gives the same HVL_x, as does 25 cm water. Kerma in air, needed to produce a net film density of 1.00 was determined and its inverse, expressed in mGy^{-1}, was taken as an indicator of the sensitivity; here called the sensitivity class of a screen-film system.

5507 Microbiology

Refer also to citation(s) 25525, 25532, 25681, 25733, 25961, 26522, 27268, 27462, 27516

27532 Clay enhancement of methane, low molecular weight hydrocarbon and halocarbon conversion by methanotrophic bacteria. Apel, W.A.; Dugan, P.R. To Dept. of Energy. 1991. USA

patent application 7-738,001. 28p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. Order Number DE93015728. Source: OSTI; NTIS; GPO Dep.

The invention described in this report relates to a combined system of an apparatus and a method of increasing the rates of oxidation of gases and hazardous vapors by methanotrophic and other bacteria. The gases of interest are methane and trichlorethylene and other hazardous vapors. In a preferred embodiment, the oxidation rate of methane is improved by the addition of clays, e.g., kaolin, sometimes called "China clay."

5509 Pathology

Refer also to citation(s) 27649

5520 Public Health

Refer also to citation(s) 25659, 25852, 25854

27533 (LBL–32165-Rev.4) **Public census data on CD-ROM at Lawrence Berkeley Laboratory: Revision 4.** Merrill, D.W. Lawrence Berkeley Lab., CA (United States). 12 Mar 1993. 46p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. Order Number DE93015231. Source: OSTI; NTIS; GPO Dep.

The Comprehensive Epidemiologic Data Resource (CEDR) and Populations at Risk to Environmental Pollution (PAREP) projects, of the Information and Computing sciences Division (ICSD) at Lawrence Berkeley Laboratory (LBL), are using public socioeconomic and geographic data files which are available to CEDR and PAREP collaborators via LBL's computing network. At this time 89 CD-ROM diskettes (approximately 45 gigabytes) are on line via the Unix file server cedrcd.lbl.gov. Most of the files are from the US Bureau of the Census, and many of these pertain to the 1990 Census of Population and Housing. All the CD-ROM diskettes contain documentation in the form of ASCII text files. In addition, printed documentation for most files is available for inspection at University of California Data and Technical Assistance (UC DATA), tel. (510) 642-6571, or the UC Documents Library, tel. (510) 642-2569, both located on the UC Berkeley Campus. Many of the CD-ROM diskettes distributed by the Census Bureau contain software for PC compatible computers, for easily accessing the data. Shared access to the data is maintained through a collaboration among the CEDR and PAREP projects at LBL, and UC DATA, and the UC Documents Library. LBL is grateful to UC DATA and the UC Documents Library for the use of their CD-ROM diskettes. Shared access to LBL facilities may be restricted in the future if costs become prohibitive. Via the Sun Network File System (NFS), these data can be exported to Internet computers for direct access by the user's application program(s). Due to the size of the files, this access method is preferred over File Transfer Protocol (FTP) access.

5530 Agriculture and Food Technology

Refer also to citation(s) 25927, 25928, 25929, 25930, 25931, 25932, 25933, 25934, 25935, 25936, 25937, 25938, 25939, 25940, 25942, 26441, 26539, 26540, 27193, 27515

27534 (AECS-A/FRSR–67) **Effects of gamma radiation on faba bean seed beetle Bruchus Dentipes Bande.** Mansour, Mohammed (Atomic Energy Commission, Damascus (Syrian Arab Republic)); Al-Bachir, Mahfouz. Atomic Energy Commission, Damascus (Syrian Arab Republic). Apr 1993. [26p.] (In Arabic). Order Number DE93630771. Source: OSTI; NTIS (US Sales Only); INIS.

Faba bean, Vivia bata, is one of the most important agricultural legume plants in Syria. Like any other crop, it is attacked by several insect pests. The most important of these is the faba bean seed beetle, Bruchus Dentipes Baudi. Infestation occurs only in the field and the major source of infestation is infested seed used for planting. The average infestation rate is about 45% and this reduces the economic value of the seeds to less than 50%. Chemical control in the field is effective but too expensive. Treating seeds in storage with fumigants is not as effective as it used to be, probably because of the pest developing resistance. Biological control has been investigated but their is no practically acceptable biological control agent at present. The lack of an effective biological control agent and/or economically acceptable and environmentally sound chemical control has led us to investigate the possibility of using gamma radiation to disinfest faba bean seeds as soon as possible after harvest when the insect is still in its early development stages. Infested faba bean seeds were treated immediately after harvest with 4 levels of gamma radiation ranged from 30 to 120 Gy with 30 Gy intervals. Treatment was repeated 15 and 30 days later and the effect of gamma radiation on larval survival was evaluated. The results showed that 90 Gy was sufficient to stop larval development and cause a 100% mortality. This dose, however, affected negatively seed germination. These results indicate that it is possible to disinfest faba bean seeds stored for human consumption with 90 Gy of gamma radiation. However, seeds destined for planting can not be treated with this dose. (author). 35 refs., 6 tabs., 2 figs.

27535 (AECS-A/RRE–9) **Accumulation of dry matter and nitrogen in the developing seeds of high protein mutant lines of Triticum Aestivum (L.) produced by the IAEA.** Mir Ali, N. (Atomic Energy Commission, Damascus (Syrian Arab Republic). Dept. of Radiation Agricuture); Nabulsi, I. Atomic Energy Commission, Damascus (Syrian Arab Republic). Mar 1993. [14p.] (In Arabic). Order Number DE93630765. Source: OSTI; NTIS (US Sales Only); INIS.

Accumulation patterns of dry matter and nitrogen in the developing seeds of nine mutant lines produced by the IAEA and their mother Triticum Aestivum (L.) line were studied. The experiments lasted 2 years under rain fed conditions. Significant differences were found among the lines in dry matter and nitrogen rates, and periods of accumulation, whereas no significant differences were found in the final seed weight of the lines. The highest rates of accumulation for dry matter and nitrogen were accompanied with the shortest period of accumulation in two late flowering mutant lines. However, these two lines were the lowest in their yield per plot. The other mutant lines achieved the high nitrogen percentage in their seeds through the relative reduction in dry matter accumulation rate compared to their mother line rather than through higher rate of nitrogen accumulation. This study revealed some of the potential reasons behind the higher percentage of protein in the seeds of the mutant lines under investigation. (author). 17 refs., 3 figs., 2 tabs.

27536 (AECS-A/RRE–10) **A study on the effect of low doses gamma radiation on mushroom spawn.** Ajlouni, Said (Atomic Energy Commission, Damascus (Syrian Arab Republic)). Atomic Energy Commission, Damascus (Syrian Arab Republic). Mar 1993. [10p.] (In Arabic). Order Number DE93630763. Source: OSTI; NTIS (US Sales Only); INIS.

Mushroom spawn (Hybrid-521) was irradiated at room temperature using low doses of gamma radiation (50-600 rad). The spawn was then planted at two stages; first, after 24 hours of irradiation, and second after storage for three weeks at refrigeration temperature. Results of this study showed that the applied doses of gamma radiation did not have any stimulatory effect on mushroom growth or productivity. It was also noticed that mushroom production rate decreased when irradiated spawn was stored for three weeks prior to planting, as compared with spawn planted 24 hours after irradiation. (author). 18 refs., 2 figs., 2 tabs.

27537 (AECS-A/RRE–11) **Determination of gamma ray doses suitable for mutation induction in garlic (Allium sativum L.).** Al-Safadi, Bassam (Atomic Energy Commission, Damascus (Syrian Arab Republic)); Ayyoubi, Zouhair. Atomic Energy Commission, Damascus (Syrian Arab Republic). Apr 1993. [11p.] (In Arabic). Order Number DE93630764. Source: OSTI; NTIS (US Sales Only); INIS.

Garlic (Allium sativum L.) cloves were exposed to different doses of gamma radiation (Control, 100, 250, 500, 750, and 1000 rads). The cloves were planted in 4 replicates at Deer Alhajar station of the Dept. of Radiation Agriculture. Number of surviving plants was recorded at 2 months after planting and at harvest. Length of foliage was measured at harvest time and weight of cloves was taken two weeks after harvest. Visual readings in the field on plant shape and leaf color were also taken. The results indicated a negative effect of gamma radiation on plant survival especially at doses of 750 and 1000 rads where no plants survived until harvest. Plant length and clove weight were reduced even at 500 rad dose. Percentage of yellow and necrotic plants increased with increasing gamma ray

dosage. No stimulation of plant growth was noticed as a result of irradiation with low doses of gamma rays. Treatment with 500 rads of gamma radiation was considered the best among tested doses for garlic mutagenesis (Using cloves) since it gave acceptable rate of survival and morphologic variation. (author). 14 refs., 4 figs.

27538 (AECS-A/RSS–50) **Effect of gamma radiation on garlic storage under natural conditions.** Ayyoubi, Zouhair (Atomic Energy Commissiom, Damascus (Syrian Arab Republic)); Sharabi, N.E. Atomic Energy Commission, Damascus (Syrian Arab Republic). Feb 1993. [17p.] (In Arabic). Order Number DE93630775. Source: OSTI; NTIS (US Sales Only); INIS.

Garlic cloves were exposed to 30, 60, and 100 Gy of gamma radiation using Co^{60} as a sources, to study the effect of different doses on the sprout inhibition of garlic. All the doses applied were effective. No sprout occurred in any of the treatments subjected to natural storage conditions. The effect of irradiation was evident in limiting the weight decrease. It reached 12 - 19% in 1987 and 1988 experiments respectively after 320 days of storage. Irradiation had no effect on the garlic consumptive specifications compared to the control. (author). 4 refs., 2 figs., 5 tabs.

27539 (AECS-A/RSS–54) **Radioimmunoassay and other related techniques.** Zarkawi, Moutaz (Atomic Energy Commission, Damascus (Syrian Arab Republic)). Atomic Energy Commission, Damascus (Syrian Arab Republic). Apr 1993. [42p.] (In Arabic). Order Number DE93630785. Source: OSTI; NTIS (US Sales Only); INIS.

The article reviews principles, requirements and reliability criteria of radioimmunoassay (RIA). Since basic reactions involved in RIA and related techniques are derived from reactions which take place in the immune system (IS) of humans and animals, the IS and the way it works will be described. In addition to RIA which involves the use of isotopes as tracers (labels), other non-radioisotopic and recent immunoassay techniques i.e. enzyme-linked immunosorbent assay (ELISA), chemiluminescence immunoassay (CLIA) and fluoroimmunoassay (FIA) will be dealt with. Some important and related terms will be defined and explained. (author). 59 refs., 4 figs.

27540 (DOE/CE/15474–T3) **Mikkelson sweep/spike chisel plow shovel: Economic summary of the 1992 crop season.** North Dakota State Univ., Langdon, ND (United States). Langdon Research Center. [1992]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG01-91CE15474. Order Number DE93015634. Source: OSTI; NTIS; GPO Dep.

Profitability comparisons are reported between the Mikkelson Sweep/Spike Chisel Plow Shovel standard sweeps. This evaluation covers the first year of testing of the new Sweep/Spike design. The data are not averaged over treatments due to significant interaction between treatments and environmental factors. The cost of fuel, fall and spring, to perform the various treatments ranged from $1.27 to $3.36 per acre. Use of the sweep/spike shovel always reduced total fuel cost. Savings varied from $0.11 to $0.71 per acre depending on prior treatment. This means there will be money saved, to off-set expenses, when converting present chisel plows or for special options on new chisel plows, needed for use of the sweep/spike shovel. A summary of 1991–1992 energy measurements. They indicate that more power will be required to pull a chisel plow equipped with the sweep/spike shovel. A larger tractor, narrower chisel plow and/or slower speed will be required to avoid the wheel slippage problems encountered on soft or wet field surfaces.

27541 (DOE/ER/20037–2) **Mechanisms and genetic control of interspecific crossing barriers in Lycopersicon: Second yearly progress report.** Mutschler, M.A. (Cornell Univ., Ithaca, NY (United States)); McCormick, S. Cornell Univ., Ithaca, NY (United States). 27 Mar 1993. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-91ER20037. Order Number DE93015931. Source: OSTI; NTIS; GPO Dep.

This study employs Lycopersicon esculentum and L. pennellii as model systems to study the interspecific reproductive barriers unilateral incongruity (UI), hybrid breakdown and interspecific aberrant ratio syndrome (IARS).

27542 (IAEA-TECDOC–695, pp. 19-31) **Behaviour of endosulfan in a model rice-fish ecosystem.** Jebakumar, S.R.D. (Madurai Kamaraj Univ., Madurai (India). Dept. of Biotechnology); Jayaraman, J. International Atomic Energy Agency, Vienna (Austria). Mar 1993. (CONF-9111316–: Final research co-ordination meeting on use of isotopes in studies of pesticides in rice-fish ecosystems, Bangkok (Thailand), 11-15 Nov 1991). In *Use of isotopes in studies of pesticides in rice-fish ecosystems: Report of a final research co-ordination meeting held in Bangkok, Thailand, 11-15 November 1991.* [130p.] Order Number DE93629395. Source: OSTI; NTIS (US Sales Only); INIS.

The levels of endosulfan deposited on rice plant leaves were low compared to reported field values. Even these values reduced to very low levels (75% or 0.06 mg/kg) in about 11 days. The half-life was 5 days. Endosulfan was strongly bound to the soil and extractability was very low. The compound percolated from the field area through soil at the rate of about 5μg cm^{-1} day^{-1}. Metabolism takes place in the soil; endosulfan sulfate and alcohol were detected. However, no stoichiometric relationship could be derived. There was also variation in the concentrations of α and β isomers, but specific correlation was not possible. There was no tendency to bioaccumulation. Endosulfan ether was detected in Hydrilla verticillata. (author). 9 refs, 5 figs, 6 tabs.

27543 (IAEA-TECDOC–695, pp. 33-45) **Fate of endosulfan in a rice-fish ecosystem.** Barredo Medina, M.J. (University of the Philippines, Los Banos (Philippines). Pesticide Toxicology and Chemistry Lab.); Calumpang, S.M.F.; Tejada, A.W.; Medina, J.R.; Magallona, E.D. International Atomic Energy Agency, Vienna (Austria). Mar 1993. (CONF-9111316–: Final research co-ordination meeting on use of isotopes in studies of pesticides in rice-fish ecosystems, Bangkok (Thailand), 11-15 Nov 1991). In *Use of isotopes in studies of pesticides in rice-fish ecosystems: Report of a final research co-ordination meeting held in Bangkok, Thailand, 11-15 November 1991.* [130p.] Order Number DE93629395. Source: OSTI; NTIS (US Sales Only); INIS.

The persistence of endosulfan in a rice field and its potential for adverse effects on rice-fish culture, was evaluated. Endosulfan was applied at the rate of 0.5 kg. AI/ha 30 days after transplanting. Residues were at a maximum at 2 h. Degradation of total residues followed pseudo-first order kinetics with half-lives of 1.2, 1.3 and 1.0 day in paddy soil, water and rice leaves, respectively. In paddy soil, maximum residues were 0.48 and 0.58 mg/kg for the alpha- and beta- isomers, respectively. In paddy water, the maxima for both alpha- and beta- isomers were 0.12 ug/L. In the rice leaves, the maxima for alpha- and beta- endosulfan were 2.75 and 1.56 mg/kg, respectively. Both the alpha- and beta- isomers dissipated at similar rates and did not accumulate in these substrates. The residues in water were still toxic to Oreochromis mossambicus up to 18 days after spraying (17% mortality). In fish, the bioconcentration factor was determined to be 9 (head) and 82 (flesh) for the alpha-isomer and 171 (head) and 279 (flesh) for the beta-isomer. (author). 18 refs, 6 figs, 2 tabs.

27544 (IAEA-TECDOC–695, pp. 47-51) **Residues of ^{14}C-endosulfan in plant, soil, and water of a rice ecosystem.** Gonzales, B.P. (University of the Philippines, Diliman, Quezon City (Philippines). Natural Sciences Research Inst.); Bello, F.B.B. International Atomic Energy Agency, Vienna (Austria). Mar 1993. (CONF-9111316–: Final research co-ordination meeting on use of isotopes in studies of pesticides in rice-fish ecosystems, Bangkok (Thailand), 11-15 Nov 1991). In *Use of isotopes in studies of pesticides in rice-fish ecosystems: Report of a final research co-ordination meeting held in Bangkok, Thailand, 11-15 November 1991.* [130p.] Order Number DE93629395. Source: OSTI; NTIS (US Sales Only); INIS.

Alpha- and beta-^{14}C-endosulfan residue data were generated from experiments conducted in a model rice-fish ecosystem. All fish put into the ecosystem ten days after spraying died within twenty-four hours. Replacements continued to die until six weeks after spraying beta-endosulfan and until five weeks after spraying alpha-endosulfan. However, a rapid decline in ^{14}C-activity with time was observed in all the components of the ecosystem. At harvest time, grain contained ^{14}C-level equivalent to less than 0.001 mg/kg of alpha- and beta- endosulfan while fish contained ^{14}C equivalent to 0.002 mg/kg alpha- and beta-endosulfan. If fish are to be

cultivated in an endosulfan-treated farm, they will have to be introduced at least six weeks after spraying. If it is necessary to spray repeatedly, then it will not be feasible to raise fish in these paddies unless an alternative insecticide is used. (author).

27545 (IAEA-TECDOC–695, pp. 53-63) **Distribution and effect of ^{14}C-endosulfan in a rice paddy-fish microecosystem.** Tayaputch, N. (Department of Agriculture, Bangkok (Thailand). Div. of Agricultural Toxic Substances); Kamnerdman, A.; Chawengsri, V. International Atomic Energy Agency, Vienna (Austria). Mar 1993. (CONF-9111316–: Final research co-ordination meeting on use of isotopes in studies of pesticides in rice-fish ecosystems, Bangkok (Thailand), 11-15 Nov 1991). In *Use of isotopes in studies of pesticides in rice-fish ecosystems: Report of a final research co-ordination meeting held in Bangkok, Thailand, 11-15 November 1991.* [130p.] Order Number DE93629395. Source: OSTI; NTIS (US Sales Only); INIS.

The experiment was conducted to evaluate the behaviour of endosulfan in a simulated rice-paddy-fish simulating ecosystem. ^{14}C-endosulfan sprayed directly on rice plant was absorbed more by the shoot than the root and endosulfan sulfate was the major metabolite found at all growth stages. ^{14}C-endosulfan was highly toxic to fish causing 100% mortality from day 1 after spraying to 14 days. The α and β isomers of ^{14}C-endosulfan degraded rapidly into endosulfan sulfate. α-Endosulfan degraded faster than the β -isomer in water and rice plants whereas β -isomer was faster in soil. (author). 5 refs, 2 figs, 7 tabs.

27546 (IAEA-TECDOC–695, pp. 65-71) **Metabolism of ^{14}C-endosulfan in carp (Cyprinus carpio L).** Suh Yongtack (Chonnam National Univ., Kwangju (Korea, Republic of). Dept. of Agricultural Chemistry); Shim Jaehan; Lee Kangbong. International Atomic Energy Agency, Vienna (Austria). Mar 1993. (CONF-9111316–: Final research co-ordination meeting on use of isotopes in studies of pesticides in rice-fish ecosystems, Bangkok (Thailand), 11-15 Nov 1991). In *Use of isotopes in studies of pesticides in rice-fish ecosystems: Report of a final research co-ordination meeting held in Bangkok, Thailand, 11-15 November 1991.* [130p.] Order Number DE93629395. Source: OSTI; NTIS (US Sales Only); INIS.

Fish (Cyprinus carpio L.) were treated with LC_{10} concentration 4.49 ng/ml of ^{14}C-endosulfan to study the absorption and metabolism. In an in vivo test, endosulfan was metabolized (65-80 %) in the tissues, only the endosulfan ether was identified indicating that it is the main metabolite of detoxification in carp. However, in an in vitro test endosulfan was converted to the endosulfan α-hydroxyether, endosulfan alcohol and endosulfan ether. The maximum levels of ^{14}C in head, muscle, and gut occurred after 8 h exposure. However, the maxima were reached in liver and kidney after 15 min, 3 h respectively. Radioactivity in the tissue decreased rapidly during 8 h after treatment. The amount of total recovered ^{14}C-activity in liver, kidney and muscle of fish was about 80-90 % during the 8 h after application. The non-extractable radioactivity increased after 8 h exposure (27-31%). When endosulfan was incubated with fish liver, kidney and gut preparations, it was metabolized to watersoluble and organosoluble metabolites. The addition of NADPH resulted in rapid conversion of endosulfan to the metabolites in an in vitro test. The rate of metabolism of endosulfan in liver, kidney and gut supplemented with NADPH as a cofactor was high in the 105,000 g soluble fraction than in microsomes. (author). 9 refs, 3 figs, 4 tabs.

27547 (IAEA-TECDOC–695, pp. 73-81) **Residues of monocrotophos in a simulated model system.** Jebakumar, S.R.D. (Madurai Kamaraj Univ., Madurai (India). Dept. of Biotechnology); Jayaraman, J. International Atomic Energy Agency, Vienna (Austria). Mar 1993. Contract 5391/R1/RB. (CONF-9111316–: Final research co-ordination meeting on use of isotopes in studies of pesticides in rice-fish ecosystems, Bangkok (Thailand), 11-15 Nov 1991). In *Use of isotopes in studies of pesticides in rice-fish ecosystems: Report of a final research co-ordination meeting held in Bangkok, Thailand, 11-15 November 1991.* [130p.] Order Number DE93629395. Source: OSTI; NTIS (US Sales Only); INIS.

Monocrotophos applied to the soil showed immediate translocation in IR-20 rice plant and it was maximum on 14th day. Release of residues in the soil into water was very slow. Accumulation of monocrotophos in fish was maximum on 28th day, thereafter the residue decreased gradually. (author). 4 refs, 4 figs, 2 tabs.

27548 (IAEA-TECDOC–695, pp. 83-93) **Fate of chlorpyrifos in a model rice-fish ecosystem.** Barredo Medina, M.J. (University of the Philippines, Lost Banos (Philippines). Pesticide Toxicology and Chemistry Lab.); Calumpang, S.M.F.; Tejada, A.W.; Medina, J.R.; Magallona, E.D. International Atomic Energy Agency, Vienna (Austria). Mar 1993. (CONF-9111316–: Final research co-ordination meeting on use of isotopes in studies of pesticides in rice-fish ecosystems, Bangkok (Thailand), 11-15 Nov 1991). In *Use of isotopes in studies of pesticides in rice-fish ecosystems: Report of a final research co-ordination meeting held in Bangkok, Thailand, 11-15 November 1991.* [130p.] Order Number DE93629395. Source: OSTI; NTIS (US Sales Only); INIS.

The persistence and distribution of chlorpyrifos in a model rice-fish ecosystem and its potential for use on rice-fish culture were evaluated. Chlorpyrifos applied at the rate of 0.5 kg AI/ha had a half-life of 3.7 days in paddy water with maximum residues of 0.009 mg/Lat 2 Days After Spraying (DAS). In paddy soil, a maximum residue of 1.2 mg/kg was found 1 DAS. Chlorpyrifos residues obtained by ordinary and exhaustive extraction had half-lives of 1.7 and 2.8 days, respectively. Bound residues started to accumulate at 19 DAS. Residues were found below 20 cm in the paddy soil at 6 DAS. Residues decline in the leaves, stems and roots followed pseudo-first order kinetics with half-lives of 0.9, 1.5 and 1.2 days, respectively. Residues were not detected in the grain at harvest. They did not bioaccumulate in fish and were not toxic to Oreochromis niloticus 6 DAS. (author). 13 refs, 2 figs, 5 tabs.

27549 (IAEA-TECDOC–695, pp. 95-102) **Research on fate of fenitrothion in a rice/fish/azolla ecosystem.** Sun, J.H. (Zhejiang Agricultural Univ., Hangzhou (China). Inst. of Nuclear-Agricultural Sciences); Li, X.M.; Chen, D.F.; Chen, Z.Y. International Atomic Energy Agency, Vienna (Austria). Mar 1993. (CONF-9111316–: Final research co-ordination meeting on use of isotopes in studies of pesticides in rice-fish ecosystems, Bangkok (Thailand), 11-15 Nov 1991). In *Use of isotopes in studies of pesticides in rice-fish ecosystems: Report of a final research co-ordination meeting held in Bangkok, Thailand, 11-15 November 1991.* [130p.] Order Number DE93629395. Source: OSTI; NTIS (US Sales Only); INIS.

The fate of ^{14}C-fenitrothion was studied in a rice/fish/azolla ecosystem. Most of the applied fenitrothion was intercepted by plants and decreased with time. Fenitrothion residues in the flesh of fish were low and most of them were in the bound form. Fenitrothion concentration in water decreased rapidly with the formation of water soluble products. In soil, most of the fenitrothion was retained in the upper layer largely as bound residues. At harvest, the concentration of fenitrothion in cargo rice and flesh of fish were very low, much lower than the permitted maximum residue level, 0.2mg/kg for rice (in China), 1μg/kg for rice (codex Alimentarus), and 0.05 mg/Kg for flesh of fish (in Japan). Fenitrothion residues in early season rice-fish-azolla ecosystems had little effect to the next paddy field. (author). 3 refs, 6 tabs.

27550 (IAEA-TECDOC–695, pp. 103-110) **Residues of ^{14}C-fenitrothion in a model paddy-fish ecosystem.** Zhang Zhongliang (Sichuan Agricultural Univ., Sichuan (China). Isotope Research Lab.); Wang Huaxin; Guo Dazhi; Chen Zhiyu; Wu Suchueng. International Atomic Energy Agency, Vienna (Austria). Mar 1993. (CONF-9111316–: Final research co-ordination meeting on use of isotopes in studies of pesticides in rice-fish ecosystems, Bangkok (Thailand), 11-15 Nov 1991). In *Use of isotopes in studies of pesticides in rice-fish ecosystems: Report of a final research co-ordination meeting held in Bangkok, Thailand, 11-15 November 1991.* [130p.] Order Number DE93629395. Source: OSTI; NTIS (US Sales Only); INIS.

The distribution of ^{14}C-fenitrothion residues in a model paddy-fish ecosystem was studied. The pesticide was sprayed over the rice plants at two level: 116 mg A l/tank, 8288 kBq (as X dose) and 232 mg A l/tank, 16576 kBq (as 2X dose). The results from the study showed that the residues of the pesticide in paddy water and rice stems and leaves decreased with time, and those in the soil, rice roots and fish body increased soon after application and decreased thereafter. At harvest (77 days after pesticide application), ^{14}C residues in different components of the ecosystem expressed

as fenitrothion were: upper part of the soil: 0.50 ± 0.061 mg/kg (2X dose) and 0.27 ± 0.007 mg/kg (X dose); lower part of the soil: 0.099 ± 0.001 mg/kg (2X) and 0.038 ± 0.003 mg/kg (X); rice stems and leaves: 4.24±0.085 mg/kg (2X) and 1.78 ±0.14 mg/kg (X); brown rice: 2.10±0.15 mg/kg (2X) and 0.96±0.063 mg/kg (X); fish body: 4.34±0.30 mg/kg (2X) and 2.75±0.025 mg/kg (X); and paddy water: 2.70±0.1 μ g/L (2X). About 60-90 % of the pesticide residue in the soil and rice plants existed in bound form and tended to increase with time. No toxicity to the fish was observed when the 2X dose of the pesticide had been applied which implies that the tested dose of fenitrothion could be used safely in the paddy-fish ecosystem. (author). 5 refs, 5 tabs.

27551 (IAEA-TECDOC–695, pp. 111-117) **Study on residues of ^{14}C-Fenitrothion in a model rice-fish ecosystem and in a field rice-fish ecosystem.** Zhang Zhongliang (Sichuan Agricultural Univ., Sichuan (China). Isotope Research Lab.); Wang Huaxin; Guo Dazhi; Chen Zhiyu; Wu Suchueng. International Atomic Energy Agency, Vienna (Austria). Mar 1993. Contract 5389/RBI. (CONF-9111316–: Final research co-ordination meeting on use of isotopes in studies of pesticides in rice-fish ecosystems, Bangkok (Thailand), 11-15 Nov 1991). In *Use of isotopes in studies of pesticides in rice-fish ecosystems: Report of a final research co-ordination meeting held in Bangkok, Thailand, 11-15 November 1991.* [130p.] Order Number DE93629395. Source: OSTI; NTIS (US Sales Only); INIS.

Residues of ^{14}C-fenitrothion in a model rice-fish ecosystem and field rice-fish ecosystem were studied. When equal amounts of the pesticide were applied, the extractable residues in brown rice (equivalent to 34.3±1.9 μg/kg fenitrothion) and rice stems and leaves (20.9±1.5 μg/kg) of the model rice-fish ecosystem were 10-15 times higher than that of the field rice-fish ecosystem (4.48±0.13 μg/kg and 1.27±0.34 μg/kg respectively). Residues in upper part of the soil (6.50±0.1–8.10±0.2 μg/kg) and lower part of the soil (1.30±0.1–1.50±0.1 μg/kg) of the model rice-fish ecosystem were 10-40 times higher than that of the field rice-fish ecosystem (0.17±0.01 μg/kg). The extractable residues in paddy water of the model ecosystem (0.30 ± 0.01 μg/kg) were similar to that of the field ecosystem (0.20±0.02 μg/kg). When the fenitrothion was sprayed on the rice plants, residues in brown rice, fish body, soil and paddy water were lower than those when the pesticide was spread on the surface of the soil. (author). 4 refs, 2 tabs.

27552 (IAEA-TECDOC–696, pp. 97-106) **Detection methods for irradiated foods - review of current developments.** Hayashi, T. (National Food Research Inst., Tsukuba, Ibaraki (Japan)). World Health Organization, Manila (Philippines). Regional Office for the Western Pacific; Joint FAO/IAEA Div. of Nuclear Techniques in Food and Agriculture, Vienna (Austria). Mar 1993. (CONF-9201151–: WHO/IAEA/FAO seminar on harmonization of regulations on food irradiation in Asia and the Pacific, Kuala Lumpur (Malaysia), 20-24 Jan 1992). In *Harmonization of regulations on food irradiation in Asia and the Pacific: Proceedings of a seminar held in Kuala Lumpur, Malaysia, 20-24 January 1992.* [211p.] Order Number DE93629035. Source: OSTI; NTIS (US Sales Only); INIS.

The identification of irradiated foods is important for authorities, consumers, traders and the food industry. It is difficult to determine whether unlabelled foods have been irradiated or not. It is recommended that irradiated foods should be clearly labelled as such, but there is nevertheless a need for reliable methods to detect irradiated foods. This article reviews some detection methods, especially electron spin resonance, and luminescence, although other physical, chemical and biological methods are also discussed.

27553 (IAEA-TECDOC–696, pp. 21-26) **Food irradiation technology - A general overview of its benefits and limitations.** Tape, N. World Health Organization, Manila (Philippines). Regional Office for the Western Pacific; Joint FAO/IAEA Div. of Nuclear Techniques in Food and Agriculture, Vienna (Austria). Mar 1993. (CONF-9201151–: WHO/IAEA/FAO seminar on harmonization of regulations on food irradiation in Asia and the Pacific, Kuala Lumpur (Malaysia), 20-24 Jan 1992). In *Harmonization of regulations on food irradiation in Asia and the Pacific: Proceedings of a seminar held in Kuala Lumpur, Malaysia, 20-24 January 1992.* [211p.] Order Number DE93629035. Source: OSTI; NTIS (US Sales Only); INIS.

Food production and marketing are being transformed by urbanization, technological change, consumer demands, regulatory requirements and increasing interdependence among countries and regions. In every country, the agri-food sector is a large, vital component of economic development, both in national and international terms. Within this changing environment, the commercialization of new agri-food technologies is becoming more difficult and challenging. Food irradiation appears to be facing similar objections to those experienced by "pasteurization" many decades ago. However, a general consensus has been achieved among governments that irradiation, from gamma or electron sources, can contribute positively to food security, safety and global food trade. Intergovernmental collaboration has lead to standards, codes of practice, guidelines, training and good sources of information on food irradiation. Wise application of these resources in an open manner will lead to the successful introduction of new food irradiation facilities and to global trade in irradiated foods. The addition of irradiation preservation to existing food technologies will broaden our overall capability to maintain agricultural and fisheries produce in a safe condition and, as well, to market quality products. (author). 10 refs.

27554 (IAEA-TECDOC–696, pp. 27-31) **The contribution of food irradiation to food safety and security.** Kaferstein, F. (World Health Organization, Geneva (Switzerland). Food Safety Unit). World Health Organization, Manila (Philippines). Regional Office for the Western Pacific; Joint FAO/IAEA Div. of Nuclear Techniques in Food and Agriculture, Vienna (Austria). Mar 1993. (CONF-9201151–: WHO/IAEA/FAO seminar on harmonization of regulations on food irradiation in Asia and the Pacific, Kuala Lumpur (Malaysia), 20-24 Jan 1992). In *Harmonization of regulations on food irradiation in Asia and the Pacific: Proceedings of a seminar held in Kuala Lumpur, Malaysia, 20-24 January 1992.* [211p.] Order Number DE93629035. Source: OSTI; NTIS (US Sales Only); INIS.

One of the objectives of the World Health Organization (WHO) is to assist efforts throughout the world to provide safe and nutritious food supplies. However, the safety and nutritional quality, as well as the mere availability of our food, is constantly threatened by contamination, infestation and deterioration. Efforts to reduce the devastating consequences of food spoilage and foodborne disease started well before the first written records. Probably the first method ever used, and one still widely employed throughout the world today, was sun-drying - simple, cheap and highly effective. In the course of tens of thousands of years, people have discovered many other methods of preserving food - salting, cooking, smoking, fermentation, canning, freezing, and preservation by chemicals. The most recent addition to this list is irradiation, i.e. the exposure of foods to carefully measured amounts of ionizing radiation. The paper will highlight the contribution this technology is expected to make with regard to the prevention of foodborne diseases and food losses. (author). 6 refs, 7 graphs.

27555 (IAEA-TECDOC–696, pp. 35-39) **Food irradiation technology - trends and progress in its commercial application.** Leemhorst, J. (Gammaster, Ede (Netherlands)). World Health Organization, Manila (Philippines). Regional Office for the Western Pacific; Joint FAO/IAEA Div. of Nuclear Techniques in Food and Agriculture, Vienna (Austria). Mar 1993. (CONF-9201151–: WHO/IAEA/FAO seminar on harmonization of regulations on food irradiation in Asia and the Pacific, Kuala Lumpur (Malaysia), 20-24 Jan 1992). In *Harmonization of regulations on food irradiation in Asia and the Pacific: Proceedings of a seminar held in Kuala Lumpur, Malaysia, 20-24 January 1992.* [211p.] Order Number DE93629035. Source: OSTI; NTIS (US Sales Only); INIS.

In a short historical overview, the development from laboratory use of X-ray machines to large scale industrial irradiation facilities is given. A comparison between machine sources and isotope sources is made and advantages and disadvantages of each are discussed. Technical considerations in irradiator designs like penetration depth, dose uniformity ratio, dose distribution, product dimensions, process parameters, etc. and the limits in optimalization of process conditions are presented. The economics of scale play an important role in radiation processing. The high initial investment and the skilled staff required to operate an irradiation facility can only be economically justified by the irradiation of large

volumes. The dependence on (seasonal) availability of food products and the still limited application of the food irradiation processes are discussed. A typical multi-purpose irradiator, the pallet irradiator, will be presented and major aspects of operation are considered. Principles of Good Manufacturing Practices and Good Irradiation Practice and its practical implications for food irradiation are discussed. The influence of population growth, industrialization, social and cultural developments on the actual and future application of the food irradiation process will be discussed and an attempt will be made to identify important trends. (author). 6 refs.

27556 (IAEA-TECDOC–696, pp. 41-51) **Development of food trade in the Asia and Pacific region and prospects for commercial application of food irradiation.** Olsen, B. (International Trade Centre UNCTAD/GATT, Geneva (Switzerland)). World Health Organization, Manila (Philippines). Regional Office for the Western Pacific; Joint FAO/IAEA Div. of Nuclear Techniques in Food and Agriculture, Vienna (Austria). Mar 1993. (CONF-9201151–: WHO/IAEA/FAO seminar on harmonization of regulations on food irradiation in Asia and the Pacific, Kuala Lumpur (Malaysia), 20-24 Jan 1992). In *Harmonization of regulations on food irradiation in Asia and the Pacific: Proceedings of a seminar held in Kuala Lumpur, Malaysia, 20-24 January 1992.* [211p.] Order Number DE93629035. Source: OSTI; NTIS (US Sales Only); INIS.

The paper will briefly analyse the Asia and Pacific Region's position in international food trade, giving details of the Region's exports of food products to the world and the internal trade in food products of the region. The paper will identify export products which can be seen as the most likely candidates for food irradiation. Furthermore, tariff and non-tariff barriers effecting a decision on the use of food irradiation for export products will be discussed. In major import markets, consumer group resistance continues to negatively effect the attitude and acceptance of the trade to deal in irradiated food products. Could the development of national and regional trade in selected irradiated food products represent a basis for a gradual, universal development of trade in these products? (author). 9 tabs, 6 charts.

27557 (IAEA-TECDOC–696, pp. 73-82) **Technical parameters to be standardized with special reference to dosimetry and authorized doses.** Roberts, P. (DSIR Physical Sciences, Lower Hutt (New Zealand). Nuclear Sciences Group). World Health Organization, Manila (Philippines). Regional Office for the Western Pacific; Joint FAO/IAEA Div. of Nuclear Techniques in Food and Agriculture, Vienna (Austria). Mar 1993. (CONF-9201151–: WHO/IAEA/FAO seminar on harmonization of regulations on food irradiation in Asia and the Pacific, Kuala Lumpur (Malaysia), 20-24 Jan 1992). In *Harmonization of regulations on food irradiation in Asia and the Pacific: Proceedings of a seminar held in Kuala Lumpur, Malaysia, 20-24 January 1992.* [211p.] Order Number DE93629035. Source: OSTI; NTIS (US Sales Only); INIS.

Dosimetry is fundamental to any irradiation processing operation. When food is processed, accurate dosimetry is required to ensure that the facility is operating as designed in terms of personnel exposure; and to validate the dose absorbed by the food, and hence to show that the process has met regulatory requirements and will produce the technical changes requested. Satisfactory dosimetry requires access to a reference dosimeter, usually held by a national regulatory agency; correct choice of a routine dosimeter; location and evaluation of the maximum and minimum dose points; and calculation of the overall average dose. Regulations may stipulate a maximum absorbed dose or maximum average absorbed dose as a safety limit for food irradiation and for some foods a minimum safety limit may also be imposed. 4 figs, 2 tabs.

27558 (IAEA-TECDOC–696, pp. 91-96) **Labelling of irradiated foods (including shipping documents) and other provisions relating to the product moving in trade.** Ladometry, L.G. (Joint FAO/IAEA Div. of Nuclear Techniques in Food and Agriculture, Vienna (Austria)). World Health Organization, Manila (Philippines). Regional Office for the Western Pacific; Joint FAO/IAEA Div. of Nuclear Techniques in Food and Agriculture, Vienna (Austria). Mar 1993. (CONF-9201151–: WHO/IAEA/FAO seminar on harmonization of regulations on food irradiation in Asia and the Pacific, Kuala Lumpur (Malaysia), 20-24 Jan 1992). In *Harmonization of regulations on food irradiation in Asia and the Pacific: Proceedings of a seminar held in Kuala Lumpur, Malaysia, 20-24 January 1992.* [211p.] Order Number DE93629035. Source: OSTI; NTIS (US Sales Only); INIS.

Like all other food, irradiated foods must be packaged in an appropriate manner. Any general provision in the food law and regulations requiring the use of appropriate packaging and packaging materials are applicable to irradiated foods. In addition, all countries that have introduced regulations on food irradiation require that irradiated foods should be labelled to indicate that irradiation has been used in their processing.

27559 (IAEA-TECDOC–696, pp. 115-121) **Quarantine treatment of fresh fruits using irradiation - recent development in market potential and future prospects for Asia and the Pacific.** Loaharanu, P. (Joint FAO/IAEA Div. of Nuclear Techniques in Food and Agriculture, Vienna (Austria)). World Health Organization, Manila (Philippines). Regional Office for the Western Pacific; Joint FAO/IAEA Div. of Nuclear Techniques in Food and Agriculture, Vienna (Austria). Mar 1993. (CONF-9201151–: WHO/IAEA/FAO seminar on harmonization of regulations on food irradiation in Asia and the Pacific, Kuala Lumpur (Malaysia), 20-24 Jan 1992). In *Harmonization of regulations on food irradiation in Asia and the Pacific: Proceedings of a seminar held in Kuala Lumpur, Malaysia, 20-24 January 1992.* [211p.] Order Number DE93629035. Source: OSTI; NTIS (US Sales Only); INIS.

Agricultural exports are important sources of foreign exchange for many developing countries in Asia and the Pacific. These horticultural commodities from countries endemic with quarantine pests, especially fruit fly of the Tephritidae family, have to be treated to satisfy strict regulations on plant protection and quarantine in major importing countries. The prohibition of ethylene dibromide (EDB) as a food fumigant by the US Environmental Protection Agency in 1984 followed by Japan's Ministry of Agriculture, Forestry and Fisheries in 1987, have jeopardized trade in fresh fruits and vegetables originating from tropical and sub-tropical countries. Alternative treatments to satisfy quarantine regulations have been used with limited degree of success. Irradiation by gamma rays has been demonstrated as a viable alternative. The USDA Animal Plant Health Inspection Service (APHIS) accepted irradiation as a quarantine treatment against various species of fruit fly infesting Hawaiian papaya in early 1989. The North American Plant Protection Organization also accepted irradiation as a quarantine treatment of fresh fruits and vegetables in late 1989. A review will be made on the status of research and development on irradiation as a quarantine treatment especially as viable method to overcome trade barriers on tropical fruits. Research carried out under the sponsorship of FAO and IAEA in the past five years demonstrated that a minimum radiation dose of 150 Gy is effective to disinfest fruits and vegetables against all species of fruit fly tested without affecting the quality of host commodities. A minimum dose of 300 Gy is effective against mango seed weevil, mites and other insects which are subject to quarantine restrictions in certain importing countries. An international protocol to demonstrate the efficacy of irradiation as a quarantine treatment on a practical scale will be described. 10 refs, 4 tabs.

27560 (IAEA-TECDOC–696, pp. 147-154) **The Asian regional co-operative project on food irradiation with emphasis on process control and acceptance: Progress and achievements.** Nair, P.M. (Bhabha Atomic Research Centre, Bombay (India)). World Health Organization, Manila (Philippines). Regional Office for the Western Pacific; Joint FAO/IAEA Div. of Nuclear Techniques in Food and Agriculture, Vienna (Austria). Mar 1993. (CONF-9201151–: WHO/IAEA/FAO seminar on harmonization of regulations on food irradiation in Asia and the Pacific, Kuala Lumpur (Malaysia), 20-24 Jan 1992). In *Harmonization of regulations on food irradiation in Asia and the Pacific: Proceedings of a seminar held in Kuala Lumpur, Malaysia, 20-24 January 1992.* [211p.] Order Number DE93629035. Source: OSTI; NTIS (US Sales Only); INIS.

Many countries in the Asian region have performed active research to develop irradiation technology to the present status, and some countries have already processed certain food items and ingredients for commercial use. Other countries are in the process of formulating regulations governing trade in irradiated foods. The

task of the Asian Regional Co-operative Project on Food Irradiation is the transfer of technology by developing suitable infrastructure, liaising with food industries in the region, harmonizing regulations and removing disparities for a co-ordinated effort to popularize the technology. 1 tab.

27561 (IAEA-TECDOC–696, pp. 185) **Food irradiation in Bangladesh.** Nurul Islam, A.S.M. (Bangladesh Standards and Testing Inst., Dacca (Bangladesh)). World Health Organization, Manila (Philippines). Regional Office for the Western Pacific; Joint FAO/IAEA Div. of Nuclear Techniques in Food and Agriculture, Vienna (Austria). Mar 1993. (CONF-9201151–: WHO/IAEA/FAO seminar on harmonization of regulations on food irradiation in Asia and the Pacific, Kuala Lumpur (Malaysia), 20-24 Jan 1992). In *Harmonization of regulations on food irradiation in Asia and the Pacific: Proceedings of a seminar held in Kuala Lumpur, Malaysia, 20-24 January 1992.* [211p.] Order Number DE93629035. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. BANGLADESH/food processing; BANGLADESH; FOOD INDUSTRY; IRRADIATION; REGULATIONS

27562 (IAEA-TECDOC–696, pp. 187-188) **Application of food irradiation in China.** Xu Jinkang (Institute of Food Safety Control and Inspection, Beijing (China)); Kan Xuegui; Song Yufang. World Health Organization, Manila (Philippines). Regional Office for the Western Pacific; Joint FAO/IAEA Div. of Nuclear Techniques in Food and Agriculture, Vienna (Austria). Mar 1993. (CONF-9201151–: WHO/IAEA/FAO seminar on harmonization of regulations on food irradiation in Asia and the Pacific, Kuala Lumpur (Malaysia), 20-24 Jan 1992). In *Harmonization of regulations on food irradiation in Asia and the Pacific: Proceedings of a seminar held in Kuala Lumpur, Malaysia, 20-24 January 1992.* [211p.] Order Number DE93629035. Source: OSTI; NTIS (US Sales Only); INIS.

The People's Republic of China views irradiation technology as an important means of food processing and preservation which is worthy of further development. It is expected that ongoing research and education programmes will ensure that consumers come to accept this technology as they have other food preservation procedures. It is the responsibility of the government to develop food irradiation by paying attention to and promoting cooperation between research, government, industry and consumers.

27563 (IAEA-TECDOC–696, pp. 191-192) **Food irradiation in Malaysia - Current status of application and regulatory control.** Ariffin, A. (Ministry of Health, Kuala Lumpur (Malaysia)). World Health Organization, Manila (Philippines). Regional Office for the Western Pacific; Joint FAO/IAEA Div. of Nuclear Techniques in Food and Agriculture, Vienna (Austria). Mar 1993. (CONF-9201151–: WHO/IAEA/FAO seminar on harmonization of regulations on food irradiation in Asia and the Pacific, Kuala Lumpur (Malaysia), 20-24 Jan 1992). In *Harmonization of regulations on food irradiation in Asia and the Pacific: Proceedings of a seminar held in Kuala Lumpur, Malaysia, 20-24 January 1992.* [211p.] Order Number DE93629035. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. MALAYSIA/food processing; MALAYSIA/radiopreservation; FOOD INDUSTRY; MALAYSIA; RADIOPRESERVATION; PUBLIC OPINION

27564 (IAEA-TECDOC–696, pp. 193-194) **Current situation of food irradiation in the Philippines.** Alabastro, E.F. (Metro Manila, Manila (Philippines). Dept. of Science and Technology); Angeles, O.R.; Parce, C.J. World Health Organization, Manila (Philippines). Regional Office for the Western Pacific; Joint FAO/IAEA Div. of Nuclear Techniques in Food and Agriculture, Vienna (Austria). Mar 1993. (CONF-9201151–: WHO/IAEA/FAO seminar on harmonization of regulations on food irradiation in Asia and the Pacific, Kuala Lumpur (Malaysia), 20-24 Jan 1992). In *Harmonization of regulations on food irradiation in Asia and the Pacific: Proceedings of a seminar held in Kuala Lumpur, Malaysia, 20-24 January 1992.* [211p.] Order Number DE93629035. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. PHILIPPINES/radicidation; PHILIPPINES/radurization; FOOD INDUSTRY; FOOD PROCESSING; FRUITS; PHILIPPINES; RADICIDATION; RADURIZATION; REGULATIONS; SEAFOOD

27565 (IAEA-TECDOC–696, pp. 107-111) **Need for a uniform system of control for ensuring acceptance of irradiated food in trade.** Tape, N. World Health Organization, Manila (Philippines). Regional Office for the Western Pacific; Joint FAO/IAEA Div. of Nuclear Techniques in Food and Agriculture, Vienna (Austria). Mar 1993. (CONF-9201151–: WHO/IAEA/FAO seminar on harmonization of regulations on food irradiation in Asia and the Pacific, Kuala Lumpur (Malaysia), 20-24 Jan 1992). In *Harmonization of regulations on food irradiation in Asia and the Pacific: Proceedings of a seminar held in Kuala Lumpur, Malaysia, 20-24 January 1992.* [211p.] Order Number DE93629035. Source: OSTI; NTIS (US Sales Only); INIS.

As national and international trade in food increases, and as markets become more knowledgeable and demanding, all food preservation techniques must be applied in a consistent, uniform manner using recognized systems of control. Such systems are particularly relevant to irradiation since inspection of the final product cannot reveal previous handling or the treatment applied. Several UN agencies provide governments with food control assistance. FAO has a major programme to provide assistance and training on food laws and regulations, on food laboratories and inspection systems, on monitoring of contaminants, and on the formulation of national strategies for the control of food quality. Other agencies have specialized programmes relating to their primary interest. For example, the WHO focuses on food safety, both chemical and microbiological. It also promotes processes, such as irradiation which can make a contribution to primary health care. The IAEA has training and support programmes for the appropriate use of nuclear techniques in food and agriculture. Together, the three agencies support the work of the International Consultative Groups on Food Irradiation (ICGFI) which provides codes of Good Irradiation Practice, guidelines, training courses and inventories of use to regulators and industry. The key areas for control in food irradiation facilities are the design, construction and operation of the facility; personnel training; raw materials; product processing, including packaging materials; record maintenance; and the environmental impact of the overall operation. (author). 6 refs.

27566 (IAEA-TECDOC–696, pp. 123-130) **Training of personnel involved in regulatory control.** Pothisiri, P. (Ministry of Public Health, Bangkok (Thailand)). World Health Organization, Manila (Philippines). Regional Office for the Western Pacific; Joint FAO/IAEA Div. of Nuclear Techniques in Food and Agriculture, Vienna (Austria). Mar 1993. (CONF-9201151–: WHO/IAEA/FAO seminar on harmonization of regulations on food irradiation in Asia and the Pacific, Kuala Lumpur (Malaysia), 20-24 Jan 1992). In *Harmonization of regulations on food irradiation in Asia and the Pacific: Proceedings of a seminar held in Kuala Lumpur, Malaysia, 20-24 January 1992.* [211p.] Order Number DE93629035. Source: OSTI; NTIS (US Sales Only); INIS.

Food irradiation can offer its full potential benefit only if irradiation facilities and processes are subject to strict control measures. The training of personnel involved in the process and inspection or control of the process and facilities must form an integral part of all food irradiation control procedures. Thus, training courses for irradiator operators, plant managers and supervisors that address proper processing with emphasis on good manufacturing practices (GMPs), dosimetry, record keeping and lot identification should be organized. For food control officials, training in the appropriate inspection procedures required for food irradiation facilities and processes is essential. Last but not least, voluntary compliance is deemed as an ideal but conceivable strategy to sustain and acceptable degree of quality assurance and facilitate effective control and hence should be promoted. (author). 13 refs.

27567 (IAEA-TECDOC–696, pp. 131-138) **Status of regulatory control of food irradiation in Asia and the Pacific identification of gaps and discussion of need for harmonization.** Pothisiri, P. (Ministry of Public Health, Bangkok (Thailand)). World Health Organization, Manila (Philippines). Regional Office for the Western Pacific; Joint FAO/IAEA Div. of Nuclear Techniques in Food and Agriculture, Vienna (Austria). Mar 1993. (CONF-9201151–: WHO/IAEA/FAO seminar on harmonization of

regulations on food irradiation in Asia and the Pacific, Kuala Lumpur (Malaysia), 20-24 Jan 1992). In *Harmonization of regulations on food irradiation in Asia and the Pacific: Proceedings of a seminar held in Kuala Lumpur, Malaysia, 20-24 January 1992.* [211p.] Order Number DE93629035. Source: OSTI; NTIS (US Sales Only); INIS.

Among the countries in the Asia and Pacific Region, the status of regulatory control of food irradiation varies from country to country. Such controls range from being non-existent to the application of the recommended Codex Standard on Irradiated Foods and related code of practice. The details of regulatory control in each of the countries of the region that have established regulations are discussed and gaps in these controls have been identified. Regulatory control on food irradiation is indispensable for a country in order to safeguard consumers as well as to facilitate trade. Without regulatory control systems, countries may not be in a position to accommodate irradiated foods in their market. Inappropriate regulatory requirements or inefficient enforcement may, in fact, act as an obstacle to development in the food irradiation industry and international trade in irradiated foods. Hence, harmonization of regulatory control systems should further enhance the development and acceptance of the food irradiation process and trade. Strategies for harmonization could be carried out in two steps: First, the countries must try to develop national policy and directives for food irradiation control as part of their universal food control laws/regulations and strictly adhere to the principles and approaches of good irradiation practice. Secondly, effective enforcement of regulatory control which is consistent with international standards must be developed. (author). 9 refs, 5 tabs.

27568 (IAEA-TECDOC–696, pp. 141-145) **Control of good irradiation practices and the role of the ICGFI guidelines and codes.** Tape, N. World Health Organization, Manila (Philippines). Regional Office for the Western Pacific; Joint FAO/IAEA Div. of Nuclear Techniques in Food and Agriculture, Vienna (Austria). Mar 1993. (CONF-9201151–: WHO/IAEA/FAO seminar on harmonization of regulations on food irradiation in Asia and the Pacific. Kuala Lumpur (Malaysia), 20-24 Jan 1992). In *Harmonization of regulations on food irradiation in Asia and the Pacific: Proceedings of a seminar held in Kuala Lumpur, Malaysia, 20-24 January 1992.* [211p.] Order Number DE93629035. Source: OSTI; NTIS (US Sales Only); INIS.

Considerable guidance is available to managers of an irradiator plant on ways and means to produce safe, wholesome, quality irradiated foods. The foundation for good manufacturing practices (GMPs), which apply to all food processes, is the Codex General Principles of Food Hygiene. These principles provide good common sense procedures in the handling of food for human consumption in order to ensure safe, wholesome quality products. The GMPs cover the growing, harvesting, preparation, processing, packaging, storage, transport, distribution and sale of food. They provide good check lists for safety and quality. More detailed guidelines specifically aimed at food irradiation are found in the Codex Code of Practice for the Operation of Irradiation Facilities and in the Codes of Good Irradiation Practice (GIPs) developed by the International Consultative Group on Food Irradiation. GIPs are available for eight commodity groups. They provide guidance on pre-irradiation handling (including microbiological guidelines), packaging, pre-irradiation storage and transport, irradiation facilities and absorbed doses, post-irradiation storage and handling, final product specifications, labelling, re-irradiation and the quality of irradiated products. In order to apply GIPs effectively, it recommended that the Hazard Analysis Critical Control Point concept (HACCP) be implemented. The HACCP concept emphasizes prevention of, rather than detection of defects. The HACCP concept has been adopted by the Codex Alimentarius Commission and is being applied to Codex Codes of Practice. (author). 7 refs.

27569 (IAEA-TECDOC–696, pp. 155-160) **A harmonized approach to regulating food irradiation based on groups of foods.** Bradford, R. (Joint FAO/IAEA Div. of Nuclear Techniques in Food and Agriculture, Vienna (Austria)); Loaharanu, P. World Health Organization, Manila (Philippines). Regional Office for the Western Pacific; Joint FAO/IAEA Div. of Nuclear Techniques in Food and Agriculture, Vienna (Austria). Mar 1993. (CONF-9201151–: WHO/IAEA/FAO seminar on harmonization of regulations on food irradiation in Asia and the Pacific, Kuala Lumpur (Malaysia), 20-24 Jan 1992). In *Harmonization of regulations on food irradiation in Asia and the Pacific: Proceedings of a seminar held in Kuala Lumpur, Malaysia, 20-24 January 1992.* [211p.] Order Number DE93629035. Source: OSTI; NTIS (US Sales Only); INIS.

Current national approvals to irradiate food are usually specific to a particular food item; even where a whole class of food (e.g. spices) is referred to in approval documentation, clearance is often limited to a specified list of items within that class. Issue of clearances in this way can lead to undue expenditure of effort on the part of industry and regulatory authorities in submitting and approving repetitive applications to irradiated food items which may be almost identical to others cleared previously. International trade in irradiated foods may be impeded if the specific food items approved in potential exporting and importing countries do not coincide, despite being closely related. It is, therefore, proposed that governments should, wherever possible, adopt a policy of issuing clearances for the irradiation of foodstuffs on a class by class basis, rather than on the basis of individual food items. Justifications for such regulatory actions in terms of economics, facilitating trade and harmonization of regulations will be provided. (author). 1 tab.

27570 (IAEA-TECDOC–696, pp. 177-181) **Acceptance of food irradiation by governments - identification of possible impediments to progress.** Pothisiri, P. (Ministry of Public Health, Bangkok (Thailand)). World Health Organization, Manila (Philippines). Regional Office for the Western Pacific; Joint FAO/IAEA Div. of Nuclear Techniques in Food and Agriculture, Vienna (Austria). Mar 1993. (CONF-9201151–: WHO/IAEA/FAO seminar on harmonization of regulations on food irradiation in Asia and the Pacific, Kuala Lumpur (Malaysia), 20-24 Jan 1992). In *Harmonization of regulations on food irradiation in Asia and the Pacific: Proceedings of a seminar held in Kuala Lumpur, Malaysia, 20-24 January 1992.* [211p.] Order Number DE93629035. Source: OSTI; NTIS (US Sales Only); INIS.

Alongside traditional methods of processing and preserving food, the technology of food irradiation is gaining more and more attention around the world. According to the recent information published by FAO and WHO, 37 countries have cleared irradiated foods and/or irradiated food ingredients for human consumption and international trade in irradiated foods seems to be gaining momentum as food irradiation receives more attention from food industries, particularly in Asia and the Pacific. In a number of countries in Asia and the Pacific, however, the irradiation process and irradiated foods is still not receiving full government acceptance with some governments establishing a moratorium on the process, some are formulating their position and some have not yet considered the suitability of irradiation technology. The main obstacles appear to be associated with consumer uncertainty, The non-existence of/or inadequate regulatory control system, techno-economical bottlenecks and socio-political complications. Each of these major obstacles are addressed in this paper, together with a suggested way forward. The two key issues are the need to address concerns and correct myths about food irradiation through a comprehensive campaign which includes an extensive education programme for the general public in order to promote consumer acceptance and the need for governments to ensure that adequate regulatory measures on food irradiation control are enacted and effectively enforced. (author). 2 refs.

27571 (IAEA-TECDOC–696, pp. 195-200) **Food irradiation control in Thailand.** Rangsaritvutikul, P. (Thai Industrial Standards Inst., Bangkok (Thailand)). World Health Organization, Manila (Philippines). Regional Office for the Western Pacific; Joint FAO/IAEA Div. of Nuclear Techniques in Food and Agriculture, Vienna (Austria). Mar 1993. (CONF-9201151–: WHO/IAEA/FAO seminar on harmonization of regulations on food irradiation in Asia and the Pacific, Kuala Lumpur (Malaysia), 20-24 Jan 1992). In *Harmonization of regulations on food irradiation in Asia and the Pacific: Proceedings of a seminar held in Kuala Lumpur, Malaysia, 20-24 January 1992.* [211p.] Order Number DE93629035. Source: OSTI; NTIS (US Sales Only); INIS.

This document discusses the current status of food irradiation in Thailand, with particular emphasis placed on the regulatory controls of the process. 6 refs, 3 figs.

27572 (IAEA-TECDOC–696, pp. 201-203) **The safety of irradiated food in Viet Nam.** Bui Minh Duc (National Inst. of Nutrition, Hanoi (Viet Nam)); Huynh Hong Nga. World Health Organization, Manila (Philippines). Regional Office for the Western Pacific; Joint FAO/IAEA Div. of Nuclear Techniques in Food and Agriculture, Vienna (Austria). Mar 1993. (CONF-9201151–: WHO/IAEA/FAO seminar on harmonization of regulations on food irradiation in Asia and the Pacific, Kuala Lumpur (Malaysia), 20-24 Jan 1992). In *Harmonization of regulations on food irradiation in Asia and the Pacific: Proceedings of a seminar held in Kuala Lumpur, Malaysia, 20-24 January 1992.* [211p.] Order Number DE93629035. Source: OSTI; NTIS (US Sales Only); INIS.

The use of irradiation in food preservation has developed rapidly in Viet Nam, and the effects of combining irradiation and other processes on the nutritional value of foods have been extensively studied. This article contains a summary of special decrees for irradiated food issued by the Ministry of Health in November 1989. 8 refs, 1 tab.

27573 (IAEA-TECDOC–707) **Improving the diagnosis and control of trypanosomiasis and other vector-borne diseases of African livestock using immunoassay methods: Results of an FAO/IAEA/DGIS co-ordinated research programme.** Joint FAO/IAEA Div. of Nuclear Techniques in Food and Agriculture, Vienna (Austria). Jun 1993. [174p.] Order Number DE93630772. Source: OSTI; NTIS (US Sales Only); INIS.

This publication contains the results presented by the participants of the Co-ordinated Research Programme (CRP) on improving the diagnosis and control of trypanosomiasis and other vector-borne diseases of African livestock using immunoassay methods. The CRP lasted from 1987 until 1992. The individual contributions have been indexed separately. Refs, figs and tabs.

27574 (IAEA-TECDOC–707, pp. 27-35) **Diagnostic methods in trypanosomiasis of livestock.** Luckins, A.G. (Centre for Tropical Veterinary Medicine, Midlothian (United Kingdom)). Joint FAO/IAEA Div. of Nuclear Techniques in Food and Agriculture, Vienna (Austria). Jun 1993. In *Improving the diagnosis and control of trypanosomiasis and other vector-borne diseases of African livestock using immunoassay methods: Results of an FAO/IAEA/DGIS co-ordinated research programme.* [174p.] Order Number DE93630772. Source: OSTI; NTIS (US Sales Only); INIS.

In domesticated livestock infected with pathogenic trypanosomes the clinical signs of disease are not pathognomonic and parasitological methods of diagnosis fail to detect all infected animals, especially those with chronic disease. Consequently, there has been a great deal of interest in immunological approaches to diagnosis, especially in the past few years since the development of monoclonal antibodies has led to considerable improvement in serological techniques. Trypanosomes elicit strong humoral immune responses and antibodies can be detected readily in infected animals. Although many different serological tests have been used for diagnosis of trypanosomiasis, currently most attention is directed towards primary binding assays, particularly enzyme linked immunosorbent assays (ELISA). Although these assays show a high level of diagnostic sensitivity, the persistence of antibodies for several months in the serum of recovered animals precludes identification of those with active infections. Modifications of the ELISA to detect circulating trypanosomal antigen in infected animals by the use of species-specific monoclonal antibodies against Trypanosoma brucei/evansi, T. congolense and T. vivax will not only overcome this problem but also provide information on the infecting trypanosome species. The use of a particular diagnostic strategy, however, will depend on the epidemiological circumstances of the disease. It is likely that these requirements will differ depending on which particular trypanosome species is involved, which method of control is being employed and what measure of post control surveillance is envisaged. None of the tests presently used is 100% sensitive and so for the foreseeable future a combination of clinical, parasitological and immunological tests will continue to be needed for the diagnosis of trypanosomiasis. (author). 29 refs, 1 fig., 4 tabs.

27575 (IAEA-TECDOC–707, pp. 37-41) **Diagnostic techniques for animal trypanosomiasis: What future for serology?.** Connor, R.J. (Regional Tsetse and Trypanosomiasis Control Programme, Harare (Zimbabwe)). Joint FAO/IAEA Div. of Nuclear Techniques in Food and Agriculture, Vienna (Austria). Jun 1993. In *Improving the diagnosis and control of trypanosomiasis and other vector-borne diseases of African livestock using immunoassay methods: Results of an FAO/IAEA/DGIS co-ordinated research programme.* [174p.] Order Number DE93630772. Source: OSTI; NTIS (US Sales Only); INIS.

The urgent requirement for improved food production in sub-Saharan Africa means that the diagnosis of animal trypanosomiasis must be improved at the producer level. Veterinary field staff have to be properly equipped to do their routine work which includes general diagnostic duties. No single diagnostic method is suitable in all circumstances, and so several methods may have to be used in a complementary manner. Ag-ELISAs have an obvious role in epidemiological studies, disease surveillance and research, but in the latter area they may soon be supplemented or even replaced by DNA techniques. (author). 5 refs, 2 tabs.

27576 (IAEA-TECDOC–707, pp. 43-50) **Application of the ELISA antigen-detection technique for the detection of apparent drug resistance trypanosome strains in Senegal.** Diaite, A. (Senegales Agricultural Research Inst. (ISRA), Dakar (Senegal). National Lab. for Stock-Breeding and Veterinary Research); Seye, M.; Vassiliades, G.; Mane, A.; Ndiaye, T. Joint FAO/IAEA Div. of Nuclear Techniques in Food and Agriculture, Vienna (Austria). Jun 1993. In *Improving the diagnosis and control of trypanosomiasis and other vector-borne diseases of African livestock using immunoassay methods: Results of an FAO/IAEA/DGIS co-ordinated research programme.* [174p.] Order Number DE93630772. Source: OSTI; NTIS (US Sales Only); INIS.

The antigen ELISA technique for the detection of trypanosomal antigens of Tryponosoma brucei, T. congolense and T. vivax in serum was used in a two part study in the South-Central region of Senegal (Sokone region), which is infested by tsetse flies. The first part of the study consisted of validating the technique at the Senegalese Institute for Agricultural Research (ISRA). The second part of the study involved use of the technique to study the incidence of trypanosomiasis in a Diakore (Zebu-N dama cross) breeding area and to detect drug resistant trypanosome strains. In the drug resistance study, preliminary investigations involved the examination of 196 samples using the ELISA and Buffy Coat Technique, while in a second investigation 883 samples were examined. The animals were treated with Berenil, then with Samorin and finally with Ethidium according to defined protocols. The results obtained indicated the existence of drug resistant strains but further investigations including subinoculation of animals and laboratory trials are needed to confirm these findings. (author). 6 refs, 9 tabs.

27577 (IAEA-TECDOC–707, pp. 51-57) **The use of an antigen-detection ELISA for the diagnosis of trypanosome infections in N'dama cattle in Gambia.** Faye, J. (International Trypanotolerant (ITC). Banjul (Gambia)). Joint FAO/IAEA Div. of Nuclear Techniques in Food and Agriculture, Vienna (Austria). Jun 1993. In *Improving the diagnosis and control of trypanosomiasis and other vector-borne diseases of African livestock using immunoassay methods: Results of an FAO/IAEA/DGIS co-ordinated research programme.* [174p.] Order Number DE93630772. Source: OSTI; NTIS (US Sales Only); INIS.

An antigen-detection enzyme-linked immunosorbent assay (Ag-ELISA) for the detection of circulating trypanosomal antigens was evaluated for use in the diagnosis of trypanosomiasis in N'dama cattle in Gambia. Initial evaluation was carried out in cattle kept in areas of low or high tsetse challenge. Overall, approximately 12% of samples were parasite, but 67% showed presence of circulating antigens. The overall apparent sensitivity of the Ag-ELISA was 75%. In a separate experiment, the effects of treatment of antigenaemic N'dama cattle on weight gain and packed cell volume (PCV) was determined in animals kept under low level natural tsetse challenge. No differences were found in PCVs between drug treated and untreated animals but there was a significant weight gain in the drug treated group. Comparison of the same parameters in cattle in which parasites were detected by buffy coat technique

(BCT), cattle which were Ag-ELISA positive but BCT negative, and cattle which were Ag-ELISA negative and BCT negative revealed little differences in weight, but PCVs were significantly lower in animals with a patent parasitaemia. (author). 4 refs, 4 figs, 3 tabs.

27578 (IAEA-TECDOC–707, pp. 59-64) **The use of antigen-detection ELISA (Ag-ELISA) in diagnosing bovine trypanosomiasis and assessing the efficacy of chemotherapy in North West Ghana.** Doku, C.K. (Central Veterinary Lab., Tamale (Ghana). Tsetse Control Unit). Joint FAO/IAEA Div. of Nuclear Techniques in Food and Agriculture, Vienna (Austria). Jun 1993. In *Improving the diagnosis and control of trypanosomiasis and other vector-borne diseases of African livestock using immunoassay methods: Results of an FAO/IAEA/DGIS co-ordinated research programme.* [174p.] Order Number DE93630772. Source: OSTI; NTIS (US Sales Only); INIS.

Ag-ELISA was used for the diagnosis of bovine trypanosomiasis in low and medium tsetse challenge areas of North-Western Ghana. At the Livestock Breeding Station (LBS), a low tsetse challenge area, parasites were detected by the buffy coat technique (BCT) in 12 (3.9%) of 304 animals while in the medium challenge area, Koduziegu, the prevalence rate was 6.8%. Using Ag-ELISA, the prevalence rates were 20.1% at LBS and 26.7% in Koduziegu showing that Ag-ELISA was 4-5 times more sensitive than the buffy coat technique. When the results of the two tests were combined, the prevalence rates rose to 23.4% at the LBS and 30.8% at Koduziegu indicating the complementary of the two tests. The most common trypanosome species detected in the two areas using the buffy coat technique was T. congolense (43.9%) followed by T. vivax (34.1%) and T. brucei (19.5%) with a ratio of single to mixed infections of 2:1. In contrast, by Ag-ELISA T. vivax was most often present (55.3%) followed by T. congolense (40.9%) and T. brucei (24.2%). Over 17% of the animals showed presence of mixed infections involving two or three trypanosome species. A pilot control project using chemotherapy was carried out in a trypanosomiasis endemic area. Blood was collected from 60 Zebu cattle; 24 of the animals had parasitaemia while 42 had circulating antigens. Forty four (73.3%) animals had PCV values below 30%. Four weeks after treatment with Berenil only 3 (5%) animals had parasitaemia while 33 (55%) still showed evidence of circulating antigens. The number of animals with PCV values greater than 30% also rose from 16 to 34. By the end of the study, when cattle had been treated on five occasions, 90% of the cattle had PCV values equal to or greater than 30% even though antigenaemia persisted in 23 cattle. (author). 5 refs, 4 figs, 1 tab.

27579 (IAEA-TECDOC–707, pp. 65-68) **Evaluation of monoclonal antibody-based antigen detection immunoassays for the diagnosis of trypanosoma congolense and T. vivax in Mali.** Diall, O. (Laboratorie Central Veterinaire du Mali, Bamako (Mali)); Diarra, B.; Sanogo, Y. Joint FAO/IAEA Div. of Nuclear Techniques in Food and Agriculture, Vienna (Austria). Jun 1993. In *Improving the diagnosis and control of trypanosomiasis and other vector-borne diseases of African livestock using immunoassay methods: Results of an FAO/IAEA/DGIS co-ordinated research programme.* [174p.] Order Number DE93630772. Source: OSTI; NTIS (US Sales Only); INIS.

A monoclonal antibody-based ELISA test for the detection of circulating antigens of T. congolense and T. vivax in infected cattle was evaluated in cattle populations in both endemic and tsetse-free areas. The sensitivity of the assay for T. vivax based on correlation of positive results with the presence of overt, patent parasitaemia was unsatisfactory but a higher, more satisfactory sensitivity was obtained with T. congolense. Analysis of sera obtained from cattle kept in areas considered free from tsetse and tick borne diseases, indicated that the assays had a high specificity with a relatively low proportion of sera showing reactions for presence of T. congolense or T. vivax antigens. (author). 8 refs, 2 tabs.

27580 (IAEA-TECDOC–707, pp. 69-77) **The validation of an Ag-ELISA for the diagnosis of trypanosomiasis in cattle in Uganda and its use in assessing the efficacy of a control programme.** Okuna, N.M. (Uganda Trypanosomiasis Research Organisation (UTRO), Tororo (Uganda)); Mayende, J.S.P.; Magona, J. Joint FAO/IAEA Div. of Nuclear Techniques in Food and Agriculture, Vienna (Austria). Jun 1993. In *Improving the diagnosis and control of trypanosomiasis and other vector-borne diseases of African livestock using immunoassay methods: Results of an FAO/IAEA/DGIS co-ordinated research programme.* [174p.] Order Number DE93630772. Source: OSTI; NTIS (US Sales Only); INIS.

An antigen detection ELISA (Ag-ELISA) for the diagnosis of trypanosomiasis was established in UTRO. The Ag-ELISA was used to assess the efficacy on an integrated tsetse and trypanosomiasis control programme which started in June 1991. Cattle were screened for trypanosomiasis using parasitologial tests and the Ag-ELISA. Cattle in Masafu where no control was implemented were screened for comparison with areas where control had been applied. Six months from the onset of control there was a reduction in the prevalence of trypanosomiasis throughout the control area. Six months from the onset of control there was a reduction in the prevalence of trypanosomiasis through the control area. Six months later, prevalence of trypanosomiasis had started rising throughout the control area with the exception of Buteba, where 1% Deltamethrin (Spot-on) had been applied to cattle. In Buteba the presence of trypanosomiasis was only detectable by Ag-ELISA. In Masafu where there was no control, prevalence of trypanosomiasis remained high. The Ag-ELISA consistently showed the presence of greater levels of infection than was revealed by microscopic methods and its usefulness was confirmed both as a means of monitoring the effectiveness of the control campaign and in identifying individual animals with non-patent active infections. 6 refs, 7 figs, 1 tab.

27581 (IAEA-TECDOC–707, pp. 79-86) **Antigen-detection enzyme-linked immunoassay (Ag-ELISA) as an aid to the diagnosis of animal trypanosomiasis in Tanzania.** Mbwambo, H.A. (Animal Disease Research Inst. (ADRI), Dar-es-Salaam (Tanzania)); Mpokwa, M.H. Joint FAO/IAEA Div. of Nuclear Techniques in Food and Agriculture, Vienna (Austria). Jun 1993. In *Improving the diagnosis and control of trypanosomiasis and other vector-borne diseases of African livestock using immunoassay methods: Results of an FAO/IAEA/DGIS co-ordinated research programme.* [174p.] Order Number DE93630772. Source: OSTI; NTIS (US Sales Only); INIS.

An antigen-detection, enzyme linked immunosorbent assay (Ag-ELISA) was introduced at ADRI, as an aid to the accurate diagnosis of animal trypanosomiasis. Forty cows were screened for trypanosomiasis by buffy coat technique (BCT) and Ag-ELISA once every three weeks for a total period of 57 weeks. The Ag-ELISA revealed the presence of trypanosomal antigens in 49.2% of the 716 samples; 27% were positive for trypanosomiasis by BCT. Trypanosomal antigens disappeared from the serum of infected animals between 16-30 days after treatment with a curative dose of the trypanocidal drug Berenil (10.0 mg/kg). It was concluded that Ag-ELISA considerably enhanced diagnostic capability and in addition enabled assessment of the efficacy of trypanocidal drug treatment. Subsequently, the Ag-ELISA technique was used to verify the effectiveness of the implementation of a tsetse and trypanosomiasis control programme in Mwangapwani, Zanzibar. Two hundred and eighty two cattle were bled and screened for trypanosomiasis. Using the microhaematocrit centrifuge technique (MHCT) trypanosomes were detected in 38 (13.5%) of the sampled animals whilst using Ag-ELISA, antigenaemia was detected in 61 (21.6%) cattle. Combined MHCT and Ag-ELISA results showed a trypanosomiasis point prevalence rate of 27.0% in cattle in the Mangapwani area. It was concluded that the Ag-ELISA used in combination with the MHCT/BCT will play an important role in tsetse and trypanosomiasis control programmes. 6 refs, 1 fig., 5 tabs.

27582 (IAEA-TECDOC–707, pp. 87-93) **Field validation and use of the antigen-ELISA to monitor the effectiveness of a tsetse and trypanosomiasis control campaign in the Gwembe valley, Zambia.** Sinyangwe, L.N. (Central Veterinary Research Inst. (CVRI), Lusaka (Zambia)); Munyama, G.M.; Sabbe, F.; Chitambo, H. Joint FAO/IAEA Div. of Nuclear Techniques in Food and Agriculture, Vienna (Austria). Jun 1993. In *Improving the diagnosis and control of trypanosomiasis and other vector-borne diseases of African livestock using immunoassay methods: Results of an FAO/IAEA/DGIS co-ordinated research programme.* [174p.] Order Number DE93630772. Source: OSTI; NTIS (US Sales Only); INIS.

A monoclonal antibody-based antigen-detection enzyme immunoassay (Ag-ELISA) for the diagnosis of the three major tsetse - transmitted trypanosome species which infect cattle was evaluated in areas in Zambia in which bovine trypanosomiasis is endemic. Two hundred and thirty eight (23.4%) of 1015 sera examined were positive for circulating antigens whereas only 88 (8.6%) had demonstrable parasitaemia as revealed by the buffy coat technique (BCT). With both techniques, the predominant trypanosome species detected was T. congolense. Many animals were shown by Ag-ELISA to carry mixed infections with 2 or 3 species of trypanosomes, whilst only one mixed infection was identified using the BCT. The Ag-ELISA was subsequently used to monitor the effectiveness of tsetse and trypanosomiasis control measures implemented by the Regional Tsetse and Trypanosomiasis Control Programme (RTTCP) in the Gwembe Valley, Zambia, an area declared free from tsetse flies. Five sentinel herds of 20 cattle were screened monthly for the presence of trypanosomes using the BCT and Ag-ELISA. Sampling was carried out for 12 months. No trypanosomes were detected by use of BCT, in contrast, 10% of the animals showed presence of circulating trypanosomal antigen. A number of antigenaemic animals treated with diminazene aceturate (Berenil) subsequently became negative. (author). 9 refs, 3 figs, 4 tabs.

27583 (IAEA-TECDOC–707, pp. 95-100) **Validation of the antigen ELISA in comparison with parasitological techniques for the diagnosis of bovine trypanosomiasis in Zimbabwe.** Ries, R. (Veterinary Research Lab., Harare (Zimbabwe)). Joint FAO/IAEA Div. of Nuclear Techniques in Food and Agriculture, Vienna (Austria). Jun 1993. In *Improving the diagnosis and control of trypanosomiasis and other vector-borne diseases of African livestock using immunoassay methods: Results of an FAO/IAEA/DGIS co-ordinated research programme.* [174p.] Order Number DE93630772. Source: OSTI; NTIS (US Sales Only); INIS.

The antigen ELISA (Ag-ELISA) for the detection of trypanosomal infections was used to test sera from naturally infected cattle and the results were correlated with those obtained by buffy coat technique (BCT). Sera were obtained from cattle kept in a tsetse free area to determine test sensitivity and from a second tsetse free area to obtain baseline values for a group of animals which were later to be moved to an area of high tsetse challenge. The Ag-ELISA was apparently 98.4% specific. In the area of high tsetse challenge the buffy coat technique detected 75 (26.6%) infections while the antigen ELISA detected 110 (39.0%) infections. The ELISA failed to detect antigens in some parasitologically positive animals, but the two were complementary for the diagnosis of trypanosomiasis in individual animals. An unexpectedly high proportion of antigen positive animals (25.0%) was found in the second tsetse free area but these infections could be due to non cyclical transmission indicating that although tsetse eradication may remove the vector, sub-clinical trypanosomiasis may persist in the cattle population unless measures are taken to provide adequate trypanocidal drug therapy. (author). 2 refs, 6 figs, 1 tab.

27584 (IAEA-TECDOC–707, pp. 101-109) **The use of the antigen ELISA for the monitoring of trypanosomal infections in cattle in Zimbabwe.** Ries, R. (Veterinary Research Lab., Harare (Zimbabwe)); Connor, R.J. Joint FAO/IAEA Div. of Nuclear Techniques in Food and Agriculture, Vienna (Austria). Jun 1993. In *Improving the diagnosis and control of trypanosomiasis and other vector-borne diseases of African livestock using immunoassay methods: Results of an FAO/IAEA/DGIS co-ordinated research programme.* [174p.] Order Number DE93630772. Source: OSTI; NTIS (US Sales Only); INIS.

The antigen ELISA (Ag-ELISA) for the detection of trypanosomal was used in the diagnosis of bovine trypanosomiasis in Gokwe District, an area from which tsetse flies had been cleared recently; in Hwange Communal Land, which although free from tsetse flies for 20 years, was threatened by reinvasion; and as part of a national survey of vector-borne diseases to determine the extent and prevalence of trypanosomal infections throughout the country. In Gokwe and Hwange all the animals tested were negative for parasites by Buffy Coat Technique (BCT), while the Ag-ELISA results showed that 42.9% and 32.3% respectively of the animals were infected. In the national survey, trypanosomal antigens were detected in cattle at 46.1% of the locations from which samples were collected, most of them in tsetse free areas. These results could be due to reinvasion or persistence of tsetse flies in very small numbers, residual infections of low pathogenicity, or temporary introduction of flies by transport vehicles. (author). 4 refs, 5 figs, 2 tabs.

27585 (IAEA-TECDOC–707, pp. 111-119) **Prevalence of trypanosomiasis in pastoral camels in the Butana plains, mid-eastern Sudan.** Elamin, E.A. (Khartoum Univ., Khartoum-North (Sudan). Dept. of Parasitology); Hassan, E.M.; Elbashir, M.O.A.; Luckins, A.G. Joint FAO/IAEA Div. of Nuclear Techniques in Food and Agriculture, Vienna (Austria). Jun 1993. In *Improving the diagnosis and control of trypanosomiasis and other vector-borne diseases of African livestock using immunoassay methods: Results of an FAO/IAEA/DGIS co-ordinated research programme.* [174p.] Order Number DE93630772. Source: OSTI; NTIS (US Sales Only); INIS.

A total of 1758 camels were examined for the presence of trypanosomal infections using conventional parasitological diagnostic techniques and an Ag-ELISA for the detection of circulating trypanosomal antigens. The survey was conducted mostly during the dry season from July 1989 to June 1990. Experimental studies using camels and goats indicated that trypanosomal antigens were present in the serum of infected animals 2 to 4 days after infection in camels and 2 to 7 days in goats. Following treatment, antigen disappeared within 7-14 days. In pastoral camels, patent parasitaemias were detected in 106 (6%) camels, with most of the infections occurring during the latter part of the dry season. Circulating trypanosomal antigens were present in 79 of the camels with active infections, hence the sensitivity based on the presence of a patent parasitaemia was 74.5%. In the 1652 camels in which there was no evidence of patent infection, circulating trypanosomal antigen was present in 679. The overall prevalence rate in all camels sampled was 43%. Over the period September to May there was an increase in the proportion of camels with demonstrable parasitaemia but during the same period the proportion of animals with circulating trypanosomal antigen remained at approximately 35%. (author). 16 refs, 6 figs 1 tab.

27586 (IAEA-TECDOC–707, pp. 121-130) **Use of ELISA in the diagnosis of infection and evaluation of treatment with Cymelarsan in camels infected with Trypanosoma evansi in Kenya.** Olaho-Mukani, W. (Kenya Trypanosomiasis Research Inst. (KETRI), Kikuyu (Kenya)); Omuse, J.K.; Nyang'ao, J.M.N.; Mutugi, M.W.; Ngaira, J.M.; Luckins, A.G.; Jeffires, P. Joint FAO/IAEA Div. of Nuclear Techniques in Food and Agriculture, Vienna (Austria). Jun 1993. In *Improving the diagnosis and control of trypanosomiasis and other vector-borne diseases of African livestock using immunoassay methods: Results of an FAO/IAEA/DGIS co-ordinated research programme.* [174p.] Order Number DE93630772. Source: OSTI; NTIS (US Sales Only); INIS.

A polyclonal based antigen detection enzyme immunoassay (Ag-ELISA) was validated and used for the diagnosis of camel trypanosomiasis in five localities in Kenya. The Ag-ELISA results were correlated with those of parasitological tests, namely, Buffy Coat Technique (BCT) and rodent subinoculation (RI). More animals showed evidence of infection using Ag-ELISA than when using BCT and RI, and showed infection rates ranging from 45.3% to 86.2% in sampled herds, compared with 0.8% to 18% using parasitologial tests. An overall apparent sensitivity of 74% by Ag-ELISA was obtained after screening sera from three camel herds. Higher ELISA values were observed in those herds with the highest rate of patent infection or where drug intervention was not being practised. However, the study revealed that trypanosomiasis was endemic in all the sampled herds and although treatment with quinapyramine sulphate suppressed parasitaemia, the presence of circulating trypanosomal antigens indicated the probable persistence of infection due to resistance to this drug. In experimental camels, the use of Ag-ELISA in evaluating the efficacy of Cymelarsan revealed that in more than 80% of the treated camels there appeared to be cure, characterized by the absence of both parasitaemia and circulating trypanosomal antigens. However, in a few animals relapse in parasitaemia occurred, and in a number of camels, antigenaemia persisted throughout the study period. Treatment on the basis of a positive Ag-ELISA reduced the proportion of

Ag-positive animals from 75% to 26% and parasite positive animals were no longer present at the end of the experiment. (author). 13 refs, 4 figs, 3 tabs.

27587 (IAEA-TECDOC–707, pp. 133-141) **Use of the ELISA in studies on tropical theileriosis in Morocco.** Kachani, M. (Institut Agronomique et Veterinaire Hassan II, Rabat (Morocco). Dept. de Parasitologie); Williamson, S.; Ouhelli, H. Joint FAO/IAEA Div. of Nuclear Techniques in Food and Agriculture, Vienna (Austria). Jun 1993. In *Improving the diagnosis and control of trypanosomiasis and other vector-borne diseases of African livestock using immunoassay methods: Results of an FAO/IAEA/DGIS co-ordinated research programme.* [174p.] Order Number DE93630772. Source: OSTI; NTIS (US Sales Only); INIS.

An enzyme-linked immunosorbent assay (ELISA) was developed for use in sero-epidemiological studies of theileriosis caused by Theileria annulata in Morocco. The antigen used was prepared from sonicated whole purified piroplasmas. The ELISA was used to study the serological responses in calves which where experimentally immunized with a schizont-infected attenuated cell line and challenged a month later with a lethal dose of sporozoites. The test was also used to study post vaccinal antibodies in pregnant cows and in animals immunized with different doses of the attenuated cell lines at different levels of passage. Finally, the test was used to screen sear collected from cattle in an area where infection with T. annulata was endemic before and after the theileriosis season. Sera from animals in the above studies were also analyzed using an indirect fluorescent antibody test (IFAT) with T. annulata piroplasmas in order to compare the relative sensitivities of the two tests. It was found that the piroplasma stage of T. annulata was a more appropriate stage from which to prepare antigen for use in ELISA then the sporozoite or schizont stages. A marked heterogeneity in antibody response was observed in animals vaccinated using an attenuated cell line vaccine, however, little difference in this response was seen between exotic and local animals which had not been previously exposed to infection with T. annulata. A concordance level of 91.5% was found between diagnosis by blood smears and ELISA. (author). 9 refs, 4 figs, 2 tabs.

27588 (IAEA/UNDP–INS/88/013-25) **Agricultural production - Phase 2. Indonesia. Sources and sinks of nitrogen-E phosphorus-based nutrients in cropping systems: Technical report. Report prepared for the Government of the Republic of Indonesia.** Wetselaar, R.I. United Nations Development Programme; International Atomic Energy Agency, Vienna (Austria). 1992. [23p.] Project INS/88/013;INS/5/021. Order Number DE93629392. Source: OSTI; NTIS (US Sales Only); INIS.

This document is the report of an expert mission to assist in the initiation of research on sustainable agriculture in rice-based cropping systems as related to the flow of plant nutrients, and on the use of legumes in upland cropping systems. Experimental suggestions include an investigation of the acid tolerance of different soybean strains under upland conditions, an analysis of ways to replace fertilizer nitrogen for rice crops by a green manure such as azolla, and a study of the increase in nutrient availability due to th presence of fish in a paddy field.

27589 (IAEA/UNDP–INS/88/013-TR) **Application of isotopes and radiation to increasing agricultural production - Phase 2. Indonesia. Project findings and recommendations: Terminal report. Report prepared for the Government of the Republic of Indonesia.** United Nations Development Programme; International Atomic Energy Agency, Vienna (Austria). 1992. [10p.] Project INS/88/013;INS/5/021. Order Number DE93629391. Source: OSTI; NTIS (US Sales Only); INIS.

This Phase 2 Project was primarily aimed at consolidating the advances made during the previous phase, formulating practical agricultural technologies which can be adopted by farmers, disseminating and applying these technologies, and enhancing the capability of the Centre for Application of Isotopes and Radiation (CAIR) to conduct agricultural research using nuclear and related techniques. Outputs generated by this project were generally in accordance with those anticipated in the Project Document. Some outputs have been transferred to the target beneficiaries (farmers) through existing systems of extension, in co-operation with the main implementing agency (BATAN). Other outputs have potential for further assessment, and may lead to practical applications in future. The rest remain as important contributions to scientific knowledge. The project has been managed to assure sustainability after project termination. A strong indication of such sustainability is evident in the on-going research and development work at CAIR and the adoption of transferred technologies by the end-users. To keep up with rapid global advancements in bio-science and technology, a new project on application of nuclear and related techniques in agricultural bio-science and technology would be needed in relation to the second long-term phase of the national development programmes. (author).

27590 (IAEA/UNDP–KEN/90/023-TR) **Fate of trypanocidal drugs in cattle (chemotherapy of trypanosomiasis). Kenya: Terminal report. Report prepared for the Government of Kenya.** International Atomic Energy Agency, Vienna (Austria); United Nations Development Programme. 1992. [69p.] Project KEN/90/023;KEN/5/012. Order Number DE93630773. Source: OSTI; NTIS (US Sales Only); INIS.

This document is the final report of a project to determine the fate of tryponocidal drugs in cattle. Drugs are still the primary agent in the struggle against trypanosomiasis although there is little data on their pharmacokinetics, residue levels, bioavailability rates, etc. This project aimed to provide such information for the three drugs Diminazene aceturate (Berenil), Isometamidium chloride (Samorin) and Homidium bromide (Ethidium). Figs and tabs.

27591 (INIS-mf–13539) **Decontamination of black pepper and red pepper by gamma radiation.** Oularbi, S. (Centre de Developpement des Techniques Nucleaires, Algiers (Algeria)); Mansouri, B. Secretariat d'Etat a la Recherche, Algiers (Algeria). Apr 1993. [17p.] (In French). Order Number DE93629397. Source: OSTI; NTIS (US Sales Only); INIS.

In the present work, it has been studied the decontamination of two types of spices (black pepper and red pepper) by gamma radiation. The initial microbial population of spices not treated is about 10 (7) to 10 (8) per gram. The population decrease exponentially with irradiation dose. By this, it has been established that a dose of 6 kGy reduces the microbial flora low than 10 (3) per gram. A total elimination of moulds is obtained at dose of 8 kGy.

27592 (INIS-mf–13552) **Economic and agricultural impact of mutation breeding in fruit trees.** Mutation breeding review. Spiegel Roy, P. (Volcani Center, Bet Dagan (Israel). Dept. of Fruit Breeding and Genetics). Joint FAO/IAEA Div. of Nuclear Techniques in Food and Agriculture, Vienna (Austria). May 1990. [25p.] Order Number DE93630766. Source: OSTI; NTIS (US Sales Only); INIS.

Constraints of conventional cross breeding in fruit trees, wide market acceptance of definite cultivars, especially in apple, pear, citrus and wine grape, and the increased impact of natural mutants provide incentives for mutation breeding. Only few induced mutants in fruit trees have been commercialized and are being planted on a large scale. The main method followed in mutation breeding of tree fruit has been acute irradiation of meristematic multicellular buds but, Chimera formation and reversion present a serious problem. 87 refs, 4 tabs.

27593 (INIS-mf–13554) **Induced mutations for crop improvement.** Mutation breeding review. Micke, A. (Joint FAO/IAEA Div. of Nuclear Techniques in Food and Agriculture, Vienna (Austria). Plant Breeding Section); Donini, B.; Maluszynski, M. Joint FAO/IAEA Div. of Nuclear Techniques in Food and Agriculture, Vienna (Austria). Jun 1990. [86p.] (In English, French). Order Number DE93630768. Source: OSTI; NTIS (US Sales Only); INIS.

Also included in French translation by R. Marie published as Mutation Breeding Review, no. 9.

Mutation induction has become an established tool in plant breeding to supplement existing germ plasma and to improve cultivars in certain specific traits. Hundreds of improved varieties have been released to farmers for many different crop species, demonstrating the economic value of the technology. Limitations arise mainly from the large mutagenized populations to be screened and from the unsatisfactory selection methods. Both limitations may be eased to some extent by advances in techniques of plant in-vitro culture. (author). Refs, 1 fig., 7 tabs.

27594 (INIS-mf–13555) **Impact of mutation breeding in rice: A review.** Mutation breeding review. Rutger, J.N. (Department of Agriculture, Stoneville, MS (United States). Agricultural Research Service). Joint FAO/IAEA Div. of Nuclear Techniques in Food and Agriculture, Vienna (Austria). Jul 1992. [24p.] Order Number DE93630769. Source: OSTI; NTIS (US Sales Only); INIS.

More cultivars have been developed in rice through the use of mutation breeding than in any other crop. Direct releases of mutants as cultivars began some 30 years ago, and now total 198 cultivars. During the last 20 years, increasing use has been made of induced mutants in cross-breeding programs, leading to 80 additional cultivars. Principal improvements through mutation breeding have been earlier maturity, short stature, and grain character modifications. Rice has been a popular subject of mutagenesis because it is the world's leading food crop, has diploid inheritance, and is highly self-pollinated. In recent years induced mutation has been exploited to develop breeding tool mutants, which are defined as mutants that in themselves may not have direct agronomic application but may be useful genetic tools for crop improvement. Examples include the eui gene, hull colour mutants, normal genetic male steriles, and environmentally sensitive genetic male steriles. The environmentally sensitive genetic male steriles, especially those in which male sterility can be turned on or off by different photoperiod lengths, show promise for simplifying hybrid rice seed production both in China and the USA. Future applications of mutation in rice include induction of unusual endosperm starch types, plant types with fewer but more productive tillers, dominant dwarfs, dominant genetic male steriles, extremely early maturing mutants, nutritional mutants, and in vitro-derived mutants for tolerance to herbicides or other growth stresses. Refs, 4 figs, 2 tabs.

27595 (KAERC–802/89) **Effects of the radiation exposure on the growing of the crops (1): Effects of the radiation exposure on rice seeds and young rice-plants.** Kim Hon; Sin Chun Ho. Ministry of Atomic Energy, Pyongyang (Korea, Democratic People's Republic of). Research Center for Atomic Energy. Feb 1989. [11p.] (In Korean). Order Number DE93627985. Source: OSTI; NTIS (US Sales Only); INIS.

In this paper have been considered the effects of the radiation exposure on seeds of the rice sorts of P-15, OCh-6 and PB-3 and young rice plants grown for 50 days. When rice seeds are exposed in the intensity of 0.05Gy/s of 8-20Gy dose, the growth force of the plants can be raised to 113-150%. The growth force of young rice-plants can be raised to 112-118% when they are exposed in the intensity of 0.01Gy/s of 5-8Gy dose. (Author).

27596 (KAERC–803/89) **Effects of the radiation exposure on the growing of the crops (2): Influence of the radiation intensity on the exposure effects of the soybean seeds.** Cho Sang Gyu, A.D.; Kim Hon; Sin Chun Ho. Ministry of Atomic Energy, Pyongyang (Korea, Democratic People's Republic of). Research Center for Atomic Energy. Feb 1989. [8p.] (In Korean). Order Number DE93627986. Source: OSTI; NTIS (US Sales Only); INIS.

In this paper have been considered the influence of the dose intensity in the radiation exposure on the seeds of the soybean sorts of PL-O and K-8. The growth force of the plants increases from 103% to 114% when dose intensity is changed from 0.01Gy/s to 0.10Gy/s in the irradiation dose, whereas it lowers from 97% to 60% in the repression dose. At the critical dose the growth force of the plants according to the dose intensity rapidly lowers and most plants die within 15 days after sowing in the dose intensity of 0.10Gy/s. (Author).

27597 (KAERC–804/89) **Effects of the radiation exposure on the growing of the crops (3): Effects of the radiation exposure on maize seeds and young plants with humus pot.** Cho Sang Gyu, A.D.; Kim Hon; Sin Chun Ho. Ministry of Atomic Energy, Pyongyang (Korea, Democratic People's Republic of). Research Center for Atomic Energy. Feb 1989. [6p.] (In Korean). Order Number DE93627987. Source: OSTI; NTIS (US Sales Only); INIS.

In this paper have been considered the effects of the radiation exposure on seeds and young plants with humus pot of the maize sorts of PL-6 and O-5. The initial growing of the plants can be raised to 108-117% when maize seeds are exposed in the intensity of 0.05 Gy/s of 8-12 Gy dose. When young maize plants with humus pot are exposed in the intensity of 0.03 Gy/s of 3-8 Gy dose, the growth force of the plants can be raised to 108-116%. (Author).

27598 (SSI–92-20) **Cesium and strontium in dairy milk 1955-1990 in Sweden.** Suomela, J.; Melin, J. Swedish Radiation Protection Inst., Stockholm (Sweden). Nov 1992. [18p.] (In Swedish). Order Number DE93630776. Source: OSTI; NTIS; INIS.

The report presents the measurement results. Higher levels were recorded after the bomb tests and the Chernobyl accidents. The accumulated radiation dose from dairy milk consumed during the period 1955-1990 is estimated to 0.3 mSv.

27599 (TVA/NFERC–92/5) **Fertilizer trends.** Donaldson, R. National Fertilizer and Environmental Research Center, Muscle Shoals, AL (United States). 1992. 56p. Sponsored by Tennessee Valley Authority, Knoxville, TN (United States). (TVA-Circ.–Y-227). Order Number DE93014385. Source: OSTI; NTIS.

This fourteenth edition of Fertilizer Trends presents historical fertilizer market data to aid industry, government, and financial market analysis and planners in their study of fertilizer and agricultural market cycles, market planning, and investment decisions. A 27-year summary of the US fertilizer market is presented in graphic and tabular form. Production, use, and trade data are included for each plant nutrient and sulfur. Canadian statistics have been included because of the important role of the Canadian fertilizer industry in the US fertilizer market. World production and consumption of nitrogen, phosphate, and potash are included because of the strong influence of world markets on the domestic market. Planted acreage and plant nutrient application rates for the major crops have been included to illustrate their effect on fertilizer use. Retail prices of the leading US fertilizer materials also are given.

27600 (TVA/NFERC–92/8) **Commercial fertilizers 1992.** Berry, J.T.; Montgomery, M.H. National Fertilizer and Environmental Research Center, Muscle Shoals, AL (United States). Dec 1992. 40p. Sponsored by Tennessee Valley Authority, Knoxville, TN (United States). (TVA-Bull–Y-230). Order Number DE93014384. Source: OSTI; NTIS.

Fertilizer consumption information in the USA for 1992 submitted by state regulatory officials is presented. This includes total sales or shipments for farm and non-farm use. Liming materials were excluded. Materials used for manufacture or blending of reported fertilizers or for use in other fertilizers are excluded to avoid double-counting. The consumption of multiple-nutrient and single-nutrient fertilizers is listed. Dry bulk, fluid, and bagged classes are given. Typical fertilizers include: anhydrous ammonia, aqua ammonia, nitrogen solutions, urea, ammonium nitrates, ammonium sulfates, phosphoric acid, superphosphates, potassium chlorides, and potassium sulfates.

27601 (TVA/NFERC–93/2) **North American fertilizer capacity data.** National Fertilizer and Environmental Research Center, Muscle Shoals, AL (United States). Feb 1993. 32p. Sponsored by Tennessee Valley Authority, Knoxville, TN (United States). (TVA-Circ.–Z-329). Order Number DE93014386. Source: OSTI; NTIS.

This listing of fertilizer producers and their production capacities was compiled in February 1993 with the cooperation of the US and Canadian fertilizer industry. TVA does not guarantee the completeness or accuracy of the information. Capacity is only an indicator of supply. Nameplate capacity differs from planned production levels or actual production because plants often operate above or below design capacity. Unless reported otherwise, plant capacities are based on 340 days per year of operation. No adjustment is made for partial year operation. Information is given on the following types of fertilizers: ammonia, ammonium nitrate, nitrogen solutions, urea, ammonium sulfate, phosphate rock, wet-process phosphoric acid, ammonium phosphates, concentrated superphosphates, potash, nitric acid, superphosphoric acid, upgraded phosphoric acids, normal superphosphate, elemental phosphorus, potassium sulfate, and sulfate of potash/magnesia.

56 BIOMEDICAL SCIENCES, APPLIED STUDIES

5601 Radiation Effects

Refer also to citation(s) 25659, 25706, 25851, 25852, 25854, 25867, 25922, 26269, 26445, 26902, 27045, 27183, 27184, 27332, 27450, 27518, 27647, 27866, 28042, 28043, 28152, 28159, 28173

27602 (ANL/BIM/CP–78742) **Chemoprevention by WR-2721.** Grdina, D.J. (Argonne National Lab., IL (United States)); Carnes, B.A. Argonne National Lab., IL (United States). [1993]. 15p. Sponsored by USDOE, Washington, DC (United States); Department of Health and Human Services, Washington, DC (United States). DOE Contract W-31109-ENG-38. Grant CA-37435. (CONF-9304141–1: 2. international cancer chemo prevention conference, Berlin (Germany), 28-30 Apr 1993). Order Number DE93012907. Source: OSTI; NTIS; INIS; GPO Dep.

WR-2721 [S-2-(3-aminopropylamino)ethylphosphorothioic acid] is an effective chemopreventive agent. C57BL x BALB/c F_1 female mice, were exposed to a single whole-body dose of 206 cGy from a ^{60}Co photon source. Those groups treated with VATR-2721 (400 mg/kg) were administered the agent i.p. 30 min prior to irradiation. Over 90% of deaths were determined to be due to tumor involvement. WR-2721 afforded significant protection against life shortening due to radiation-induced tumors of connective tissue and epithelial tissue origins. Subsequent survival time in WR-2721-treated and irradiated animals as compared to matched irradiated-only controls was extended up to 59 days. A single exposure of animals to VVR-2721 did not affect the cumulative survival curves for unirradiated mice. WR-2721 possesses chemopreventive properties which can be clinically exploited to reduce the risk to therapy-induced secondary cancers in patients who otherwise would have an excellent prognosis for cure and long-term survival.

27603 (BN-SA–3768-HEDR) **Determination of key radionuclides and parameters related to dose from the Columbia River pathway: Hanford Environmental Dose Reconstruction Project.** Napier, B.A. Pacific Northwest Lab., Richland, WA (United States). Mar 1993. 125p. Sponsored by Department of Health and Human Services, Washington, DC (United States). Order Number DE93012871. Source: OSTI; NTIS; INIS.

A series of scoping calculations has been undertaken to evaluate the absolute and relative contributions of different radionuclides and exposure pathways to doses that may have been received by individuals living in the vicinity of the Hanford Site. These scoping calculations may include some radionuclides and pathways that were included in the Phase 1 Columbia River pathway dose evaluations, as well as other potential exposure pathways being evaluated for possible inclusion in future Hanford Environmental Dose Reconstruction Project (HEDR) modeling efforts. This scoping calculation (Calculation 009) examines the contributions of numerous radionuclides to dose via environmental exposures and accumulation in water, fish, and other aquatic biota. Addressed in these calculations are the contributions to effective dose from (1) external exposure to contaminated river water, (2) ingestion of contaminated drinking water, and (3) ingestion of contaminated resident Columbia River fish. Additional information on contamination of anadromous fish and waterfowl is provided.

27604 (CEA-CONF–11308) **Ice beads and decontamination.** Manificat, A. (CEA Centre d'Etudes de Grenoble, 38 (France). Dept. de Thermohydraulique et de Physique); Gauchon, J.P. CEA Centre d'Etudes de Grenoble, 38 (France). Dept. de Thermohydraulique et de Physique. 1993. [5p.] (In French). (CONF-9303194–: Meeting on Protection, Handling, Detection and Safety, Strasbourg (France), 30 Mar - 1 apr 1993). Order Number DE93630798. Source: OSTI; NTIS (US Sales Only); INIS.

Surface treatment by abrasive blasting with ice pellets was developed by the CEA to decrease the volume of effluents in maintenance and dismantling of nuclear plants. The paper describes briefly the ice generator, with a production capacity of 200 kg per hour, the means of propulsion and use of the process for various industrial operations.

27605 (CONF-910905–5) **^{222}Rn dosimetry in the dog lung.** Harley, N.H.; Meyers, O.A.; Robbins, E.S. New York Univ., NY (United States). School of Medicine. [1991]. 22p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-87ER60547. From 5. international symposium on the natural radiation environment; Salzburg (Austria); 22-28 Sep 1991. Order Number DE93014035. Source: OSTI; NTIS; GPO Dep.

The alpha dose to cells in bronchial airways in the beagle dog during historical exposures to ^{222}Rn decay products is calculated using updated information on airway morphometry, call nucleus depth, mucus thickness, physical dosimetry and atmospheric characteristics. The alpha dose per unit exposure to basal call nuclei in the upper airways ranges from 2 to 7 mGy WLM^{-1} (excluding the trachea) depending upon the exposure protocol used. The dose to alveolar tissue is 3 mGy WLM^{-1}. In the human lung, the dose factor for the bronchial airways is 9 mGy WLM_{-1} and for the pulmonary parenchyma 0.5 mGy WLM^{-1} The human tumors appear primarily in the first few branching airway generations while the only tumors observed in the animals were in the bronchioloalveolar region suggesting a difference in cell sensitivity to alpha radiation.

27606 (DOE/ER/60502–7) **The development of in vitro mutagenicity testing systems using T-lymphocytes: Research progress report, November 1, 1992–October 31, 1993.** Albertini, R.J. Vermont Univ., Burlington, VT (United States). May 1993. 21p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-87ER60502. Order Number DE93016019. Source: OSTI; NTIS; GPO Dep.

This annual report describes progress in studies on hprt mutations induced by radon or Indium 111 along with the corresponding mutation frequency, cloning and molecular spectra in human T-lymphocytes. Parallel studies on the mutation susceptibility between individuals is being investigated by hprt mutation studies on ataxia telangiectasia and xeroderma pigmentosum.

27607 (DOE/ER/60631–11) **Radiation physics, biophysics, and radiation biology: Progress report, December 1, 1992–November 30, 1993.** Hall, E.J.; Zaider, M. Columbia Univ., New York, NY (United States). Center for Radiological Research. May 1993. 69p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-88ER60631. Order Number DE93014482. Source: OSTI; NTIS; INIS; GPO Dep.

Research at the Center for Radiological Research is a multidisciplenary blend of physics, chemistry and biology aimed at understanding the mechanisms involved in the health problems resulting from human exposure to ionizing radiations. The focus is increased on biochemistry and the application of the techniques of molecular biology to the problems of radiation biology. Research highlights of the program from the past year are described. A mathematical model describing the production of single-strand and double-strand breaks in DNA as a function radiation quality has been completed. For the first time Monte Carlo techniques have been used to obtain directly the spatial distribution of DNA moieties altered by radiation. This information was obtained by including the transport codes a realistic description of the electronic structure of DNA. We have investigated structure activity relationships for the potential oncogenicity of a new generation of bioreductive drugs that function as hypoxic cytotoxins. Experimental and theoretical investigation of the inverse dose rate effect, whereby medium LET radiations actually produce an c effect when the dose is protracted, is now at a point where the basic mechanisms are reasonably understood and the complex interplay between dose, dose rate and radiation quality which is necessary for the effect to be present can now be predicted at least in vitro. In terms of early radiobiological damage, a quantitative link has been established between basic energy deposition and locally multiply damaged sites, the radiochemical precursor of DNA double strand breaks; specifically, the spatial and energy deposition requirements necessary to form LMDs have been evaluated. For the first time, a mechanically understood "biological fingerprint" of high-LET radiation has been established. Specifically measurement of the ratio of inter-to intrachromosomal aberrations produces a unique signature from alpha-particles or neutrons.

27608 (DOE/ER/60631–12) **The Radiological Research Accelerator Facility: Progress report, December 1, 1992–November 30, 1993.** Hall, E.J.; Marino, S.A. Columbia Univ., New York, NY (United States). Center for Radiological Research. May 1993. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-88ER60631. Order Number DE93014483. Source: OSTI; NTIS; INIS; GPO Dep.

The Radiological Research Accelerator Facility (RARAF) is based on a 4-MV Van de Graaff accelerator, which is used to generate a variety of well-characterized radiation beams for research in radiobiology, radiological physics, and radiation chemistry. It is part of the Center for Radiological Research (CRR) - formerly the Radiological Research Laboratory of Columbia University, and its operation is supported as a National Facility by the US Department of Energy (DOE). As such, RARAF is available to all potential users on an equal basis and scientists outside the CRR are encouraged to submit proposals for experiments at RARAF. The operation of the Van de Graaff is supported by the DOE, but the research projects themselves must be supported separately. This report provides a listing and brief description of experiments performed at RARAF during the May 1, 1992 through April 30, 1993.

27609 (EGG-M–93073) **PC edit package for testing of annual radiation dose summary data.** Millet, W.H. EG and G Idaho, Inc., Idaho Falls, ID (United States). [1993]. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. (CONF-9304128–2: Department of Energy (DOE) radiation protection conference, Las Vegas, NV (United States), 13-15 Apr 1993). Order Number DE93013666. Source: OSTI; NTIS; INIS; GPO Dep.

The purpose of this presentation is to introduce a software package for the testing of annual radiation dose summary data by the DOE contractor site prior to submitting the report to DOE's Radiation Records Repository. This software will identify most errors existing in the annual radiation dose summary data before the data leaves the originating site. This process will greatly reduce the reviewing and editing tasks of staff members at the repository. The SPMS Maintenance and Operations unit of EG&G Idaho, Inc. is charged with maintaining and operating a database for tracking and summing the annual radiation exposure data reported from DOE and DOE contractor facilities where monitoring of radiation exposure is required. This database, which is also referred to as the Radiation Records Repository, is used to generate comparative statistical data for trending and performance analysis on DOE's contracted facilities and its worker population.

27610 (ENEA-RT-GEN–91-02) **Medical activities and occupational safety.** Cenni, P.; Fagarazzi, G.; Farne, F.; Messora, A.; Bassi, P.; Speranza, A. ENEA, Bologna (Italy). Dec 1991. 30p. (In Italian). (RT/GEN–91-02). Order Number DE93799269. Source: OSTI; NTIS (US Sales Only); INIS.

This paper presents a synthesis of the activities developed within the ENEA (Italian Agency for Energy, New Technologies and the Environment) Occupational Medicine group working at its Bologna Nuclear Research Centre during the years 1989 and 1990. Besides carrying out the duties required by law concerning medical surveillance, these activities concern both service and research aspects in the field of human-computer interaction, environmental factors, microclimates, ergonomics and safety.

27611 (ETDE-IT–93-160) **Diet-meat and diet-milk transfer of ^{137}Cs in cattle: Values of dynamic model and values obtained in field.** Trenti, F.; Calamosca, M.; Pagano, P.; Cipone, M. Bologna Univ. (Italy); ENEA, Bologna (Italy). 1992. 6p. (CONF-9208231–1: World bujatric congress and American association of bovine practitioner, St. Paul, MN (United States), 31 Aug 1992). Order Number DE93799230. Source: OSTI; NTIS (US Sales Only); INIS.

In conditions of environmental radiocontamination, the vegetable-animal products-man food chain becomes particularly critical for the determination of population equivalent doses. Such doses may be predicted using contaminant transfer models such as NUCRAC-SAI, DOSDIM, NRPB, PATHWAY and others. These are principally founded on dynamic compartmental systems and they have in common the use of first degree kinetics, which lead to the formulation of a system of differential equations, the solution of which shows the trend of radionuclide concentration in time, in the various environmental and animal matrices. Efficacy verification of these analytical instruments is performed at its best in real situations of radioactive spill in the environment, such as the incident which occurred in Italy in 1986. In the latter occasion, a modulus was applied which belongs to a more complex model described below, and which uses the daily dietary intake of ^{137}Cs, to predict the meat and milk contamination variation in time, in the adult bovine. To verify the efficacy of this model, calculated values were compared against those measured directly by radiometry of meat and milk samples of the same bovines.

27612 (IAEA-TECDOC–698) **Generic intervention levels for protecting the public in the event of a nuclear accident or radiological emergency: Interim report for comment.** International Atomic Energy Agency, Vienna (Austria). Apr 1993. [92p.] Order Number DE93629414. Source: OSTI; NTIS (US Sales Only); INIS.

Many international organizations are in the process of developing common safety standards for protection against ionizing radiation and for the safety of radiation sources. This document is intended to provide input to the final specification of intervention levels, at which actions of various kinds to protect members oft the public after an accident are advised. It provides the radiation protection principles underlying such intervention levels and proposes numerical values for these levels based on an analysis of some of the more directly quantifiable factors involved. Factors such as social disruption, psychological factors and political considerations are discussed, but are explicitly excluded from the derivation. Refs, figs and tabs.

27613 (INIS-mf–12758, pp. 520-527) **Experimental ratio between the 'real' dose per organ and the calculated dose determined by means of the Embalse nuclear power plant's personal dosimeter.** Thomasz, E. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina). Gerencia de Seguridad Radiologica y Nuclear); Salas, C.A. Asociacion Argentina de Tecnologia Nuclear, Buenos Aires (Argentina). 1987. [735p.] (In Spanish). (CONF-8711355–: 15. scientific meeting and 4th Latin American meeting and 1st sessions on nuclear power plants, San Carlos de Bariloche (Argentina), 2-6 Nov 1987). In *Proceedings of the fifteenth scientific meeting; fourth Latin American meeting; first sessions on nuclear power plants.* Order Number DE91003052. Source: OSTI; NTIS (US Sales Only); INIS.

The specific purpose of the study was to determine the experimental ratio between the reading of dosimeters used by the personnel of the Embalse nuclear power plant and the 'real' dose absorbed by the worker in different organs. An anthropomorphic phantom ALDERSON internal and externally loaded with approximately 150 TLD crystals was used. This phantom was placed in five enclosures that were usually occupied by workers of the Embalse nuclear power plant. In this way, the average dose per organ and the effective equivalent dosis in each enclosure could be calculated and compared with the personal dosimeters placed over the thorax and the conversion factor rem/rem for each enclosure was determined. The average factor resulting from the five considered enclosures was 0.73 rem/rem. This means that the personal dosimeters over value the real dosis absorbed by the personnel of the Embalse nuclear power plant in approximately 37%. (Author).

27614 (INIS-mf–13543, pp. 95-109) **Effect of radon on human health.** Thomas, J. (Institut Hygieny a Epidemiologie, Prague (Czech Republic)). Ministerstvo Zivotniho Prostredi, Prague (Czech Republic); Okresni Urad, Jihlava (Czech Republic); Dum Kultury Odboru, Jihlava (Czech Republic). 1992. (In Czech). (CONF-9211241–: Conference on provisions against radon, Jihlava (Czech Republic), 23-25 Nov 1992). In *Conference on provisions against radon: Proceedings.* [232p.] Order Number DE93629294. Source: OSTI; NTIS (US Sales Only); INIS.

The action of radon and its daughter products on the epithelium of lungs is outlined. Miners are most endangered by radon risk, living in homes with elevated radon levels is hazardous as well. Mentioned are various superstitious rumors concerning the effects of radon, which spread among the uninformed population. The radon risk is compared with other life risks. The data and examples are documented with tables and graphs. (M.D.). 2 tabs., 4 figs.

27615 (INIS-mf–13543, pp. 6-13) **Controlled overpressure airing as an efficient anti-radon system in existing buildings.** Moravek, P. Ministerstvo Zivotniho Prostredi, Prague (Czech Republic); Okresni Urad, Jihlava (Czech Republic); Dum Kultury Odboru, Jihlava (Czech Republic). 1992. (In Czech). (CONF-9211241–: Conference on provisions against radon, Jihlava (Czech Republic), 23-25 Nov 1992). In *Conference on provisions against radon: Proceedings.* [232p.] Order Number DE93629294. Source: OSTI; NTIS (US Sales Only); INIS.

The regulatory limiting volume activity of radon in buildings is 200 Bq/m^3. A ventilation system that removes radon very efficiently from closed rooms so that its levels approach the outdoor background, has been designed and tested experimentally. The air conditioning unit has a throughput of 2x360 m^3/h with an electric power demand of 100 W. It includes a recuperation exchanger made of plastic whose efficiency is 74%, a fresh air bypass, replaceable filters, and a damper. The under-ceiling distribution system brings in fresh air whereas waste air is drawn off under the doors. The operation of the unit is controlled automatically applying a pre-set airing schedule. The results of trial operation were outstanding. (M.D.). 5 figs.

27616 (INIS-mf–13543, pp. 53-70) **Removal of radon-222 from water.** Hanslik, E. (Vyzkumny Ustav Vodohospodarsky, Prague (Czech Republic)). Ministerstvo Zivotniho Prostredi, Prague (Czech Republic); Okresni Urad, Jihlava (Czech Republic); Dum Kultury Odboru, Jihlava (Czech Republic). 1992. (In Czech). (CONF-9211241–: Conference on provisions against radon, Jihlava (Czech Republic), 23-25 Nov 1992). In *Conference on provisions against radon: Proceedings.* [232p.] Order Number DE93629294. Source: OSTI; NTIS (US Sales Only); INIS.

Practical procedures for removing radon from water use the aeration principle. Theoretical formulas for radon removal and examples of existing equipment are given. Aeration in pressure systems is efficient to approximately 50% and consumes much energy. A shallow water aeration equipment, called INKA, is conventionally used. Aeration towers made of polypropylene and packed with corrugated glass-reinforced plastics sheets are also employed. Radon can also be removed by adsorption on activated carbon, which is, however, an expensive approach. Radium is removed from underground water during the conventional treatment applied to eliminate manganese and iron. Water treatment plant staff must be protected against the radon risk from aeration. (M.D.). 2 tabs., 5 figs., 12 refs.

27617 (INIS-mf–13543, pp. 128-130) **Existing experience with anti-radon provisions in the Jihlava district.** Vondrak, J. (Okresni Urad, Jihlava (Czechoslovakia)). Ministerstvo Zivotniho Prostredi, Prague (Czech Republic); Okresni Urad, Jihlava (Czech Republic); Dum Kultury Odboru, Jihlava (Czech Republic). 1992. (In Czech). (CONF-9211241–: Conference on provisions against radon, Jihlava (Czech Republic), 23-25 Nov 1992). In *Conference on provisions against radon: Proceedings.* [232p.] Order Number DE93629294. Source: OSTI; NTIS (US Sales Only); INIS.

The radon contents and gamma dose rates were measured in selected houses of some towns in the Jihlava district, Czech Republic. Elevated radon levels were identified in some of the houses and remedial actions were recommended. The government can grant financial contributions for the remedial actions on request. (M.D.). 3 refs.

27618 (INIS-mf–13543, pp. 147-152) **Practical experience with the implementation of remedial actions.** Jirovec, V. (Stavebni Radonovy Servis, Hradec Kralove (Czechoslovakia)). Ministerstvo Zivotniho Prostredi, Prague (Czech Republic); Okresni Urad, Jihlava (Czech Republic); Dum Kultury Odboru, Jihlava (Czech Republic). 1992. (In Czech). (CONF-9211241–: Conference on provisions against radon, Jihlava (Czech Republic), 23-25 Nov 1992). In *Conference on provisions against radon: Proceedings.* [232p.] Order Number DE93629294. Source: OSTI; NTIS (US Sales Only); INIS.

Remedial actions consist in limiting the amount of radon entering into the buildings or in securing sufficient airing. The assets and shortcomings of the various procedures are dealt with. If radon comes from the subsoil, an aired layer under the building or controlled ventilation with heat recuperation can help. Airing is the most suitable approach if radon originates from the building material. Single-family houses of the 'START' type, which have been built using panels which contain radioactive slag from power plants, pose a specific problem. The panels must be provided with shielding from the inside or replaced. (M.D.).

27619 (INIS-mf–13543, pp. 187-210) **Technologies suitable for technical provisions aimed at reducing the radiation burden of people in homes.** Breda, M. (Centrum Stavebniho Inzenyrstvi, Praha (Czechoslovakia)); Smejkal, Z. Ministerstvo Zivotniho Prostredi, Prague (Czech Republic); Okresni Urad, Jihlava (Czech Republic); Dum Kultury Odboru, Jihlava (Czech Republic). 1992. (In Czech). (CONF-9211241–: Conference on provisions against radon, Jihlava (Czech Republic), 23-25 Nov 1992). In *Conference on provisions against radon: Proceedings.* [232p.] Order Number DE93629294. Source: OSTI; NTIS (US Sales Only); INIS.

Health physics authorities determine in which buildings remedial actions should be taken. Technical provisions to reduce the effective dose rate from indoor exposure include: forming an anti-radon barrier on the surface of walls (special amino amide resin- or epoxy resin-based coatings, special wallpapers), reducing the area from which radon leaks into the room (replacement of the harmful structural components), reducing the volume of contaminated air which enters the room (insulation from the subsoil, insulation of piping) and increased airing of the room. Examples of technological documentation are appended. (M.D.).

27620 (INIS-mf–13543, pp. 110-118) **Problems of 'START' type houses.** Thomas, J. (Institut Hygieny a Epidemiologie, Prague (Czech Republic)). Ministerstvo Zivotniho Prostredi, Prague (Czech Republic); Okresni Urad, Jihlava (Czech Republic); Dum Kultury Odboru, Jihlava (Czech Republic). 1992. (In Czech). (CONF-9211241–: Conference on provisions against radon, Jihlava (Czech Republic), 23-25 Nov 1992). In *Conference on provisions against radon: Proceedings.* [232p.] Order Number DE93629294. Source: OSTI; NTIS (US Sales Only); INIS.

The case of the assembled single-family 'START' houses is described. The houses are made of panels which include power plant slag with a high radium content. The panels were manufactured in 1965-1983. The inhabitants are exposed to whole-body photon irradiation from the masonry and to internal irradiation from inhaled radon daughters. The slag-concrete panels have a low heat-insulating capacity, which makes the inhabitants seal the windows against heat leaks, whereupon the radon concentration in the homes additionally increases. Various feasible remedial actions are described. For instance, the inner walls can be lined with additional retention walls or aluminium foils or impermeable coatings, permanent air conditioning can be installed, the house can be thermally insulated while the sealing from windows can be removed, etc. The situation is so serious that the government of the Czech Republic decided to contribute funds for the remedial actions or to buy out the houses from the householders. (M.D.). 3 figs.

27621 (INIS-mf–13543, pp. 139-146) **Contribution of the building material to the radiation burden in buildings.** Kominek, A. (Vyzkumny Ustav Stavebnich Hmot, Brno (Czech Republic)); Broz, J. Ministerstvo Zivotniho Prostredi, Prague (Czech Republic); Okresni Urad, Jihlava (Czech Republic); Dum Kultury Odboru, Jihlava (Czech Republic). 1992. (In Czech). (CONF-9211241–: Conference on provisions against radon, Jihlava (Czech Republic), 23-25 Nov 1992). In *Conference on provisions against radon: Proceedings.* [232p.] Order Number DE93629294. Source: OSTI; NTIS (US Sales Only); INIS.

A survey of building materials used in the Czech Republic and of the specific activities of ^{40}K, ^{226}Ra and ^{232}Th in these materials is presented. Czechoslovak and foreign regulatory limits for activities in building materials are given and the radiation burden of inhabitants of homes built from such materials is estimated. (M.D.). 3 tabs.

27622 (IPEN-PUB–379) **Applied in vitro radio bioassay.** Gaburo, J.C.G.; Sordi, G.M.A.A. Instituto de Pesquisas Energeticas e Nucleares (IPEN), Sao Paulo, SP (Brazil). Nov 1992. [32p.] (In Portuguese). Order Number DE93629381. Source: OSTI; NTIS (US Sales Only); INIS.

The aim of this publication is to show the concepts and in vitro bioassay techniques as well as experimental procedures related with internal contamination evaluation. The main routes of intake, metabolic behavior, and the possible types of bioassay samples that can be collected for radionuclides analysis are described. Both biological processes and the chemical and physical behavior of the radioactive material of interest are considered and the capabilities of analytical techniques to detect and quantify the radionuclides are discussed. Next, the need of quality assurance throughout procedures are considered and finally a summary of the techniques applied to the internal routine monitoring of IPEN workers is given. (author).

27623 (JINR-E–17-92-201) **Quantum phase fluctuations in the Jaynes-cummings model: effects of cavity damping.** Ho Trung Dung; Shumovskij, A.S. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Theoretical Physics. 1992. [16p.] Order Number DE93627984. Source: OSTI; NTIS (US Sales Only); INIS.

Phase properties of a coherent field interacting with a two-level atom in a cavity with very high but finite Q are studied. It is shown that due to the cavity damping the field phase is randomized more quickly than in the ideal-lossless cavity case. The Hermitian phase distribution and the phase distributions associated with the Q function and the Wigner function are compared. The similarities between them have clear interpretation in terms of the area-of-overlap in phase space. 29 refs.; 3 figs.

27624 (JINR-E–19-91-335) **Radioprotective action of glycerol and cysteamine on inactivation and mutagenesis in Salmonella tester strains after gamma and heavy ion irradiation.** Basha, S.G.; Krasavin, E.A.; Kozubek, S. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Nuclear Problems. 1991. [10p.] Order Number DE93629336. Source: OSTI; NTIS (US Sales Only); INIS.

Submitted to Mutat. Res.

Inactivation and mutagenesis were studied in Salmonella tester strains after γ-irradiation and after heavy ion irradiation in the presence of glycerol and cysteamine. Bacterial cells were irradiated at Dubna, JINR. Ions from deuterons to carbon were used with residual energies 2-9 MeV/u. The protective effect of glycerol was found both for γ-radiation and for heavy ions up to 50 keV/μm for both cell inactivation and mutagenesis in Salmonella tester strains with different mutation events. Cell sensitivity slightly increased with LET before falling down. The maximum was shifted in the presence of glycerol to the left and was less pronounced. The radioprotective effect of glycerol diminished gradually with LET from 2.0 for γ-radiation to 1.1 for carbon ions. Mutagenesis increases with LET in TA100 strain; in TA98 strain no marked increase could be detected. 13 refs.; 4 figs.; 5 tabs.

27625 (LA-UR–93-1203) **Decontaminating lead bricks and shielding.** Lussiez, G.W. Los Alamos National Lab., NM (United States). [1993]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930873–4: 2. international mixed waste symposium, Baltimore, MD (United States), 17-20 Aug 1993). Order Number DE93012662. Source: OSTI; NTIS; INIS; GPO Dep.

Lead used for shielding is often surface contaminated with radioisotopes and is therefore a RCRA D008 mixed waste. The technology-based standard for treatment is macroencapsulation. However, decontaminating and recycling the clean lead is a more attractive solution. Los Alamos National Laboratory decontaminates material and equipment contaminated with radioisotopes. Decontaminating lead poses special problems because of the RCRA hazard classification and the size of the inventory, now about 50 tons and likely to grow substantially because of planned decommissioning operations. This lead, in the form of bricks and other shield shapes, is surface contaminated with fission products. One of the best methods for decontaminating lead is removing the thin superficial layer of contamination with an abrasive medium trader pressure. For lead, a mixture of alumina with water and air at about 40 psig rapidly and effectively decontaminates the lead. The abrasive medium is sprayed onto the lead in a sealed-off area. The slurry of abrasive and particles of lead falls through a floor grating and is collected in a sump. A pump sends the slurry mixture back to the spray gun, creating a continuous process. The process generates small volumes of contaminated lead slurry that can be solidified and, because it passes the TCLP, is not a mixed waste. The decontaminated lead can be released for recycling.

27626 (LBL–31305) **Simplified modeling for infiltration and radon entry.** Sherman, M.H. Lawrence Berkeley Lab., CA (United States). Aug 1992. 23p. Sponsored by USDOE, Washington, DC (United States); Environmental Protection Agency, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-921203–12: Thermal performance of the exterior envelopes of buildings, Clearwater, FL (United States), 7-10 Dec 1992). Order Number DE93013902. Source: OSTI; NTIS; GPO Dep.

Air leakage in the envelopes of residential buildings is the primary mechanism for provided ventilation to those buildings. For radon the same mechanisms that drive the ventilation, drive the radon entry This paper attempts to provide a simplified physical model that can be used to understand the interactions between the building leakage distribution, the forces that drive infiltration and ventilation, and indoor radon concentrations, Combining both ventilation and entry modeling together allows an estimation of Radon concentration and exposure to be made and demonstrates how changes in the envelope or ventilation system would affect it. This paper will develop simplified modeling approaches for estimating both ventilation rate and radon entry rate based on the air tightness of the envelope and the driving forces. These approaches will use conventional leakage values (i.e. effective leakage area) to quantify the air tightness and include natural and mechanical driving forces. This paper will introduce a simplified parameter, the Radon Leakage Area, that quantifies the resistance to radon entry. To be practical for dwellings, modeling of the occupant exposures to indoor pollutants must be simple to use and not require unreasonable input data. This paper presents the derivation of the simplified physical model, and applies that model to representative situations to explore the tendencies to be expected under different circumstances.

27627 (LBL-PUB–3113) **Radiological Control Manual: Revision 0, January 1993.** Lawrence Berkeley Lab., CA (United States). Apr 1993. 201p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. Order Number DE93013925. Source: OSTI; NTIS; INIS; GPO Dep.

This manual has been prepared by Lawrence Berkeley Laboratory to provide guidance for site-specific additions, supplements, and clarifications to the DOE Radiological Control Manual. The guidance provided in this manual is based on the requirements given in Title 10 Code of Federal Regulations Part 835, Radiation Protection for Occupational Workers, DOE Order 5480.11, Radiation Protection for Occupational Workers, and the DOE Radiological Control Manual. The topics covered are (1) excellence in radiological control, (2) radiological standards, (3) conduct of radiological work, (4) radioactive materials, (5) radiological health support operations, (6) training and qualification, and (7) radiological records.

27628 (LYCEN–9250) **Experimental dosimetry and kinetics of radioactive tracers for human applications: example of therapeutic injection of Lipiodol labelled with Iodine 131.** Ahmed Mahidi, N. (Lyon-1 Univ., 69 (France)). Lyon-1 Univ., 69 - Villeurbanne (France). Inst. de Physique Nucleaire; Lyon-1 Univ., 69 - Villeurbanne (France). Oct 1992. [175p.] (In French). Order Number DE93630806. Source: OSTI; NTIS (US Sales Only); INIS.

We have evaluated the radiation dose received by the liver and lungs for 10 patients with a hepatic carcinoma after surgical operation followed by a therapeutic dose of Lipiodol labelled with iodine 131. The cumulated activities have been obtained by using a calibrated gamma camera. Fixation and kinetics of the I^{131} Lipiodol in normal and cancers livers have been measured with the determination of the effective and biological half-lives. The calculated doses are based on the MIRD method. Results confirm that Lipiodol fixation is important in the liver at J1 (about 74% of the injected activity). Its elimination is essentially urinary, pulmonary fixation remained low, the dose received by the healthy part of liver is acceptable. These values have been compared with those obtained by another method using a thermoluminescent dosimeter (LiF) installed on the skin over the liver. Comparison between results obtained by the 2 methods shows a good correlation.

27629 (OEFZS–4628) **Sense and purpose of radiation protection training.** Malasek, A. (Hauptabteilung fuer Schulung und Ausbildung, Bereich Marketing, Forschungszentrum Seibersdorf GmbH, Seibersdorf (Austria)). Oesterreichisches Forschungszentrum Seibersdorf GmbH (Austria). Apr 1992. [13p.] (In German). Order Number DE93628039. Source: OSTI; NTIS (US Sales Only); INIS.

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Training in radiation protection is of great significance in connection with the activities of the executive, the federal army and emergency organizations in emergency operations for the protection of the population in the case of large-scale radioactive contamination due to diverse causes. The presently valid legal situation of radiation protection training is presented in connection with the expected modification in the amendment to the SSVO. The special situation of radiation protection training for the executive, the federal army and emergency organizations is described and discussed in connection with the new aspects outlined in the draft of the new radiation protection regulation. In conclusion, problems arising in the conveyance of basic knowledge in radiation protection are illustrated by means of a concrete example. (author).

27630 (OEFZS–4670) **Lymphocytic subsets and low-dose exposure.** Tuschl, H. (Hauptabteilung Toxikologie, Bereich Lebenswissenschaften, Forschungszentrum Seibersdorf, Seibersdorf (Austria)); Kovac, R.; Eybl, E. Oesterreichisches Forschungszentrum Seibersdorf GmbH (Austria). Mar 1993. [17p.] (In German). Order Number DE93628006. Source: OSTI; NTIS (US Sales Only); INIS.

Provided with ISSN 0253-5270.

The present investigations proved the differential radiosensitivity of lymphocytic subpopulations: From in vivo and in vitro irradiations it may be followed that the most sensitive subset are CD8 positive suppressor T cells. CD4/CD8 ratios are increased both in peripheral blood and after mitogen stimulation of lymphocytes of exposed persons. The decrease in B cells is pronounced only at higher radiation doses. Though the rate of DNA synthesis after mitogen stimulation was reduced in some exposed persons, that was no general phenomenon. Especially after tritium exposure, the observed lymphopenia correlated with an increased stimulation by PHA and an increased rate of DNA synthesis in some probands. Thus the present investigations indicate that - despite an inhibition of some immune parameters by radioexposure - the body is able to maintain its immunological homoeostasis. (authors).

27631 (PNL–8500-Pt.4) **Pacific Northwest Laboratory annual report for 1992 to the DOE Office of Energy Research: Part 4, Physical sciences.** Toburen, L.H. Pacific Northwest Lab., Richland, WA (United States). Apr 1993. 79p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93013936. Source: OSTI; NTIS; INIS; GPO Dep.

This report is divided into the following sections, with technical sections in parentheses: dosimetry research (Chernobyl database, radon alpha irradiation of mammalian cells, cell growth rates in individual colonies), measurement science (ultrahigh resolution studies of molecular structure and dynamics, circular dichroism in hyperfine state resolved photoelectron angular distributions, Sr isotope shifts, capillary electrophoresis-mass spectrometry for DNA adduct research, rapid DNA sequencing techniques), and radiological and chemical physics (hit size effectiveness in radiation protection, track ends, cross sections for partially stripped ion impact, scaling of differential ionization cross sections, ionization by neutral projectiles, secondary electron emission from thin foils, stochastic model of ion track structure, stochastics of positive ion penumbra, plasmid structure and spontaneous strand separation, isolation and radiation sensitivity of DNA-synthesis-deficient CHO double mutants, semiempirical model of differential ionization cross sections for multishell atoms and molecules, ionization of DNA in solution, perturbations of DNA conformation by thymine glycol and dihydrothymine). 32 figs, 3 tabs.

27632 (PNL-SA–21596) **Eleventh DOE workshop on personnel neutron dosimetry.** USDOE Assistant Secretary for Environment, Safety, and Health, Washington, DC (United States). Office of Health. [1991]. 182p. Sponsored by USDOE, Washington, DC (United States). (CONF-9106235–: 11. Department of Energy workshop on personnel neutron dosimetry, Las Vegas, NV (United States), 4-7 Jun 1991). Order Number DE93013824. Source: OSTI; NTIS; INIS; GPO Dep.

Since its formation, the Office of Health (EH-40) has stressed the importance of the exchange of information related to and improvements in neutron dosimetry. This Workshop was the eleventh in the series sponsored by the Department of Energy (DOE). It provided a forum for operational personnel at DOE facilities to discuss current issues related to neutron dosimetry and for leading investigators in the field to discuss promising approaches for future research. A total of 26 papers were presented including the keynote address by Dr. Warren K. Sinclair, who spoke on, "The 1990 Recommendations of the ICRP and their Biological Background." The first several papers discussed difficulties in measuring neutrons of different energies and ways of compensating or deriving correction factors at individual facilities. Presentations were also given by the US Navy and Air Force. Current research in neutron dosimeter development was the subject of the largest number of papers. These included a number on the development of neutron spectrometers.

27633 (PNL-SA–21677) **Quantitative Luminescence Imaging System.** Batishko, C.R.; Stahl, K.A.; Fecht, B.A. Pacific Northwest Lab., Richland, WA (United States). [1992]. 48p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-921281–1: Workshop on 3-dimensional graphics modeling of RFR distribution in humans, Brooks AFB, TX (United States), 8-9 Dec 1992). Order Number DE93015691. Source: OSTI; NTIS; INIS; GPO Dep.

The goal of the MEASUREMENT OF CHEMILUMINESCENCE project is to develop and deliver a suite of imaging radiometric instruments for measuring spatial distributions of chemiluminescence. Envisioned deliverables include instruments working at the microscopic, macroscopic, and life-sized scales. Both laboratory and field portable instruments are envisioned. The project also includes development of phantoms as enclosures for the diazoluminomelanin (DALM) chemiluminescent chemistry. A suite of either phantoms in a variety of typical poses, or phantoms that could be adjusted to a variety of poses, is envisioned. These are to include small mammals (rats), mid-sized mammals (monkeys), and human body parts. A complete human phantom that can be posed is a long-term goal of the development. Taken together, the chemistry and instrumentation provide a means for imaging rf dosimetry based on chemiluminescence induced by the heat resulting from rf energy absorption. The first delivered instrument, the Quantitative Luminescence Imaging System (QLIS), resulted in a patent, and an R&D Magazine 1991 R&D 100 award, recognizing it as one of the 100 most significant technological developments of 1991. The current status of the project is that three systems have been delivered, several related studies have been conducted, two preliminary human hand phantoms have been delivered, system upgrades have been implemented, and calibrations have been maintained. Current development includes sensitivity improvements to the microscope-based system; extension of the large-scale (potentially life-sized targets) system to field portable applications; extension of the 2-D large-scale system to 3-D measurement; imminent delivery of a more refined human hand phantom and a rat phantom; rf, thermal and imaging subsystem integration; and continued calibration and upgrade support.

27634 (PNWD–2127-HEDR) **Approach for calculating population doses using the CIDER computer code.** Shipler, D.B. Pacific Northwest Lab., Richland, WA (United States). 29 Apr 1993. 7p. Sponsored by Department of Health and Human Services, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93012828. Source: OSTI; NTIS; GPO Dep.

This report describes an approach for calculating radiation doses for the Hanford Environmental Dose Reconstruction Project. The approach utilizes the CIDER computer code.

27635 (RFP–4713) **Establishing interim authorization bases for resumption of plutonium operations.** Ealy, K.; Satterwhite, D. EG and G Rocky Flats, Inc., Golden, CO (United States). Rocky Flats Plant. [1993]. 2p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC34-90DP62349. (CONF-9306143–7: Energy Facility Contractors Group safety analysis

meeting, Denver, CO (United States), 16-18 Jun 1993). Order Number DE93015362. Source: OSTI; NTIS; GPO Dep.

DOE Order 5480.23, Nuclear Safety Analysis Reports, requires that DOE facilities have an approved SAR (Safety Analysis Report). Rocky Flats Plant has a number of facilities for which no SAR exists. DOE Order 5480.21, Unreviewed Safety Questions, makes allowance for the operation of facilities without adequate SARs, through the establishment of an interim Authorization Basis (AB). In order to establish an AB, the nuclear facility must define the population of documents comprising the various elements of the AB and must use this defined population of documents as the basis for performing safety evaluations under DOE requirements. This short note explains the steps Rocky Flats Plant is taking to catalog the large body of documents available in order to establish an AB for those facilities needed to resume plutonium operations.

27636 (Riso-R–665(EN)) **Predicted effects of countermeasures on radiation doses from contaminated food.** Yamamoto, Hideaki (Japan Atomic Energy Research Institute (Japan)); Nielsen, S.P.; Nielsen, F. Risoe National Lab., Roskilde (Denmark). Environmental Science and Technology Dept. Feb 1993. [31p.] Order Number DE93630799. Source: OSTI; NTIS; INIS.

Quantitative assessments of the effects on radiation-dose reductions from nine typical countermeasures against accidental fod contamination have been carried out with dynamic radioecological models. The foodstuffs are assumed to be contaminated with iodine-131, caesium-134 and caesium-137 after a release of radioactive materials from the Ringhals nuclear power station in Sweden resulting from a hypothetical core melt accident. The release of activity of these radionuclides is assumed at 0.07% of the core inventory of the unit 1 reactor (1600 TBq of I-131, 220 TBq of Cs-134 and 190 TBq of Cs-137). Radiation doses are estimated for the 55,000 affected inhabitants along the south-eastern coast of Sweden eating locally produced foodstuffs. The average effective dose equivalent to an individual in the critical group is predicted to be 2.9 mSv from food consumption contaminated with I-131. An accident occurring during winter is estimated to cause average individual doses of 0.32 mSv from Cs-134 and 0.47 mSv from Cs-137, and 9.4 mSv and 6.8 mSv from Cs-134 and Cs-137, respectively, for an accident occurring during summer. Doses from the intake of radioiodine may be reduced by up to a factor of 60 by rejecting contaminated food for 30 days. For the doses from radiocaesium, the largest effect is found form deep ploughing which may reduce the dose by up to a factor of 80. (au) (12 tabs., 6 ills., 19 refs.).

27637 (SSI–92-03) **A reasonable price to prevent death caused by radiation induced neoplasms.** Bergman, C. Swedish Radiation Protection Inst., Stockholm (Sweden). Jan 1992. [17p.] (In Swedish). Order Number DE93630800. Source: OSTI; NTIS; INIS.

This paper discusses the risk based prioritization of radiation protection procedures versus the reduction of radiation induced neoplasms. An economic valuation of death reduction is necessary in many situations.

27638 (SSI–92-04) **Harmonization of models used for calculation of environmental transport and radiation doses.** Karlberg, Olof. Swedish Radiation Protection Inst., Stockholm (Sweden). Feb 1992. [24p.] (In Swedish). Order Number DE93631733. Source: OSTI; NTIS; INIS.

Models used for calculation of the environmental transport and radiation doses are presented. Differences between two models are discussed.

27639 (SSI–92-05) **Control of X-ray installations in hospitals.** Blomgren, P.G.; Hedberg Vikstroem, B. Swedish Radiation Protection Inst., Stockholm (Sweden). Mar 1992. [17p.] (In Swedish). Order Number DE93630795. Source: OSTI; NTIS; INIS.

171 quality controls of new installations of x-ray equipments have been performed. The results are summarized in this report. In average 22 percent of new installations were not approved at the first inspection.

27640 (SSI–92-09) **Measurement of radioactive wastes.** Karlberg, O.; Sandin, A.C. Swedish Radiation Protection Inst., Stockholm (Sweden). May 1992. [23p.] (In Swedish). Order Number DE93630808. Source: OSTI; NTIS; INIS.

The report presents the results of control measurement of intermediate-level and low-level radioactive wastes. Samples of encapsulated and processed radioactive wastes were controlled.

27641 (SSI–92-10) **Cost benefit of radiation protection.** Bengtsson, Gunnar (ed.). Swedish Radiation Protection Inst., Stockholm (Sweden). Mar 1992. [22p.] (In Swedish). Order Number DE93630801. Source: OSTI; NTIS; INIS.

The report discusses the cost benefit analysis necessary in the field of radiation protection.

27642 (SSI–92-16) **Biological effects of exposure to low frequency electric and magnetic fields.** Ahnstroem, G. (Stockholms Univ. (Sweden). Straalningsbiologiska Inst.). Swedish Radiation Protection Inst., Stockholm (Sweden). Oct 1992. [19p.] (In Swedish). Order Number DE93630732. Source: OSTI; NTIS; INIS.

The biological effects of exposure to low frequency electric and magnetic fields are reviewed with the objective of summarizing effects directly relevant to considerations of the health and safety of exposed people.

27643 (SSI–92-17) **Non-ionizing electromagnetic exposure assessment and dosimetry.** Paulsson, L.E. Swedish Radiation Protection Inst., Stockholm (Sweden). Nov 1992. [27p.] Order Number DE93630810. Source: OSTI; NTIS; INIS.

A comprehensive literature survey of advancements in the area 'human exposure assessment and dosimetry' for the years 1988-1992 has been performed by the author and published elsewhere. In the present report that material has been complemented with a historical background and a thorough description of the physical principles behind the methods and techniques. The report covers strategies, principles, methods, limitations and future developments for the area of human exposure assessment and dosimetry of electromagnetic fields form extremely low frequencies up to and including microwaves.

27644 (SSI–92-18) **Personnel dosimetry, 1991.** Bergman, Lars. Swedish Radiation Protection Inst., Stockholm (Sweden). Nov 1992. [12p.] (In Swedish). Order Number DE93630811. Source: OSTI; NTIS; INIS.

The report presents the results of the personnel dosimetry service during 1991. 12508 dosimeters were distributed. The results show that 7843 persons had received less than 0.1 mSv, 3864 persons between 0.1-1 mSv, 756 persons more than 1-5 mSv, and 39 persons more than 5 mSv.

27645 (STUK-A–108) **Residential radon survey in Finland.** Arvela, H.; Maekelaeinen, I.; Castren, O. Finnish Centre for Radiation and Nuclear Safety (STUK), Helsinki (Finland). Feb 1993. [52p.] (In Finnish). Order Number DE93629423. Source: OSTI; NTIS; INIS.

The study measured the indoor radon concentration in the dwellings of 3074 persons, selected randomly from the central population register of Finland. Alpha track detectors and two consecutive half year measuring periods were used. The national mean of indoor radon concentration for persons living in low-rise residential buildings as well as blocks of flats was 145 and 82 Bq/m^3, respectively. The mean for the total population was 123 Bq/m^3. Based on the decision of the Ministry of Social Affairs and Health in 1992, the indoor radon concentration should not exceed 400 Bq/m^3 in already existing houses, the target for new construction being less than 200 Bq/m^3. According to the study, the percentage of the Finnish population living in houses with an indoor radon concentration exceeding 200, 400 and 800 Bq/m^3 was 12.3 %, 3.6 % and 1.0 %.

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Refer also to citation(s) 27274, 27384, 27385, 27386, 27476, 27501

27646 (CONF-9305229–1) **RApid Screening of Hazard analysis.** Jones, T.D.; Morris, M.D.; Easterly, C.E. Oak Ridge National Lab., TN (United States). [1993]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From National Toxicology Program; Triangle Park, NC (United

States); 23-25 May 1993. Order Number DE93015813. Source: OSTI; NTIS; GPO Dep.

For synthetic fuels development, the Department of Energy was charged, in 1983, to "justify the need to monitor specific unregulated substances and of providing threshold values above which these substances must be monitored."

27647 (DOE/ER/60405–8) **Mechanisms of interaction of radiation with matter: Progress report, July 1, 1992–June 30, 1993.** Geacintov, N.E.; Pope, M. New York Univ., NY (United States). Radiation and Solid State Lab. 30 Jun 1993. 23p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-86ER60405. Order Number DE93017051. Source: OSTI; NTIS; INIS; GPO Dep.

This project is concerned with the mechanisms by which polynuclear aromatic (PNA) compounds on the one hand, and ionizing radiation on the other, cause damage to DNA. PNA compounds constitute an important class of environmental pollutants derived from energy-related sources which, upon metabolic activation to diolepoxide derivatives, produce bulky PNA-DNA lesions interfere with the normal DNA replication and transcription processes, and give rise to mutations and the initiation of tumors. Chiral and other stereochemical effects play a key role in determining the biological effects of a given PNA diol epoxide and the potentially mutagenic lesions which are formed. New and efficient methods for synthesizing stereochemically pure and precisely positioned PNA diol epoxide-DNA lesions in small DNA fragments are reported here. We have elucidated the structures of three stereoisomeric benzo[a]pyrene diol epoxide-DNA adducts. How these adducts affect on DNA polymerase fidelity, transcription, and DNA repair are currently being investigated with respect to detailed structure-biological activity correlations. Spectroscopic techniques such as circular dichroism, fluorescence, and photoionization play an important role in the characterizations of the PNA adducts. A new method was developed for measuring the lifetimes as well as the energies of picosecond duration electronically excited states. Using this technique, it is proposed that short-lived (15 ps) charge-transfer (CT) states in the PNA compound tetracene are activated by a 20 ps laser pulse; an unusual external photoemission echo do to the recombination of CT states is observed 85 ps after the pulse.

27648 (DOE/ER/61228–T1) **Center of Excellence in laser medicine: Progress performance report.** Parrish, J.A. Massachusetts General Hospital, Boston, MA (United States). Wellman Labs. of Photomedicine. 29 Apr 1993. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-91ER61228. Order Number DE93016541. Source: OSTI; NTIS; GPO Dep.

Achievements during the last 12 months of funding to initiate a Center of Excellence in biomedical laser development include: seven specific research projects within the Center's three broad interest areas, and program development to establish the MGH Laser Center and its activities. Progress in the three interest areas namely new medical laser systems development, optical diagnostics and photo sensitization is reported. Feasibility studies and prototype development were emphasized, to enhance establishing a substantial Center through future support. Specific projects are outlined below. In addition, the interdepartmental MGH Laser Center's activities and accomplishments.

27649 (LA-UR–93-1165) **DM-CSF stimulated proliferation of rat alveolar macrophages and the effects of differing particulate burden levels in alveolar macrophages on the proliferative response.** Pendergrass, D.; Valdez, Y.E.; Lehnert, B.E. Los Alamos National Lab., NM (United States). [1993]. 22p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9303155–1: 4. international inhalation symposium on toxic and carcinogenic effects of solid particles in the respiratory tract, Hanover (Germany), 1-5 Mar 1993). Order Number DE93012629. Source: OSTI; NTIS; GPO Dep.

Particles are gradually redistributed among the lung's population of alveolar macrophages (AM) at times well after they were originally deposited in the lung. One mechanism that may underlie this "particle redistribution phenomenon" is the in situ replication of particle-containing AM and the allocation of particles from dividing AM to daughter cells. Little is known about how the abilities of AM to proliferate may be affected by the containment of particles; conceivably, AM proliferation may be a particle burden-dependent process. In this study, we assessed the proliferative abilities of AM that contain differing burdens of phagocytized particles. Rats were intratracheally instilled with 2×10^8 fluorescent, polystyrene microspheres (~2 μM diam.), and several days thereafter their lungs were lavaged. The lavaged AM were analyzed using a multiparameter flow cytometer, and the AM were sorted according to their relative burdens of microspheres, i.e., low burdens, medium burdens, high burdens, based on their levels of fluorescence intensities. Control cells consisted of AM that were lavaged from the lungs of untreated animals and also passed through the flow cytometer. The sorted AM were then cultured in the presence of 0.3 ng/ml Granulocyte/Macrophage Colony-Stimulating Factor and cultured for up to 15 days. Control cells and the sorted AM all replicated similarly; no evidence was found to indicate that AM proliferation is either stimulated or decreased. Evidence was also obtained that indicated that when particle-containing AM divide, the particles they originally contained are distributed to their offspring.

27650 (ORNL/FTR–4290) **Travel to Luso, Portugal, to participate in the NATO Advanced research workshop on the use of biomarkers to assess human health and environmental impacts from exposure to chemical pollutants: Foreign trip report, May 30, 1992–June 9, 1992.** White, R.K. Oak Ridge National Lab., TN (United States). 22 Jun 1992. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93011075. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The traveler attended the workshop, Use of Biomarkers in Assessing Health and Environmental Impacts of Chemical Pollutants participating in numerous discussions with NATO scientists and researchers on the definition and character of biomarkers, analytical methods for identifying and measuring the presence of biomarkers, and the use of such markers as indicators of the health of the exposed system. Papers of particular interest to the Oak Ridge National Laboratory health risk assessment program are those discussing the use of biomarkers to indicate the health status of populations surrounding hazardous waste sites in Denver, Colorado, and in two Belgian cities. In addition, the work of several attendees in linking specific genetic biomarkers to specific tumor types and incidence indicate important advances in the use of biomarkers to link environmental exposures to specific disease states. Further refinement and advancement of these techniques will greatly advance human health risk assessment techniques.

27651 (UCRL-JC–111534) **Studies on DNA adduction with heterocyclic amines by accelerator mass spectroscopy (AMS): A new technique for tracing isotope labeled DNA adduction.** Turteltaub, K.W.; Vogel, J.S.; Frantz, C.E.; Fultz, E. Lawrence Livermore National Lab., CA (United States). 29 Sep 1992. 21p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9206374–1: Workshop on post-labeling methods on DNA adducts, Lyon (France), 24-27 Jun 1992). Order Number DE93012589. Source: OSTI; NTIS; GPO Dep.

The influence of dose on the biological damage caused by exposure to xenobiotics has long been a subject of controversy in toxicology. Of particular recent interest has been the interaction of chemical carcinogens with DNA and the relationship between DNA adduction, chemical exposure, and cancer risk. We are studying DNA adduction in rodents at doses equivalent to human dietary exposure (10^4–10^6-fold lower than laboratory studies) using accelerator mass spectrometry (AMS). AMS is a nuclear physics technique for detection of cosmogenic isotopes and has been used for specifically selecting and counting ^{14}C. Using AMS, DNA adducts are detectable at levels of 1–10 adducts/10^{12} nucleotides following acute and chronic dosing regimes with ^{14}C-labeled carcinogens. The adduct detection limit has been imposed by the natural abundance of ^{14}C in the samples and animal to animal variation. AMS is also being coupled to HIPLC, multi-dimensional TLC, and radio-immunoassay. In addition, AMS's great sensitivity makes it useful for demonstrating that drugs and chemicals don't bind DNA. The use of AMS, however, is limited to situations where radio-labeled agents can be used. These data suggest that AMS is

extremely useful in obtaining quantitative data on the effects of carcinogens on DNA at the low doses common for actual human exposures and may be useful in human studies.

5604 Other Environmental Pollutant Effects

Refer also to citation(s) 27270, 27648

27652 (CONF-9303182–1) **Current distribution tomography for determination of internal current density distributions.** Gailey, P.C. Oak Ridge National Lab., TN (United States). [1993]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Applied Computational Electromagnetic Society (ACES) meeting; Monterey, CA (United States); 24 Mar 1993. Order Number DE93015463. Source: OSTI; NTIS; INIS; GPO Dep.

A method is presented for determination of current densities inside a cylindrical object using measurements of the magnetic fields outside the object. The cross section of the object is discretized with the current assumed constant over each defined region. Magnetic fields outside the object are related to the internal current densities through a geometry matrix which can be inverted to yield a solution for the current densities in terms of the measured fields. The primary limitation of this technique results from singularities in the geometry matrix that arise due to cylindrical symmetry of the problem. Methods for circumventing the singularities to obtain information about the distribution of current densities are discussed. This process of current distribution tomography is designed to determine internal body current densities using measurements of the external magnetic field distribution. It is non-invasive, and relatively simple to implement. Although related to a more general study of magnetic imaging which has been used to investigate endogenous currents in the brain and other parts of the body, it is restricted to currents either applied directly or induced by exposure to an external field. The research is related to public concern about the possibility of health effects resulting from exposure to power frequency electric and magnetic fields.

27653 (EGG–10617-2164) **San Joaquin kit fox (Vulpes velox macrotis) program, Camp Roberts, California: Progress report, fiscal years 1991–1992.** EG and G Energy Measurements, Inc., Goleta, CA (United States). Santa Barbara Operations. Oct 1992. 40p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract AC08-88NV10617. Order Number DE93011249. Source: OSTI; NTIS; INIS; GPO Dep.

The major objective of the Camp Roberts Environmental Studies Program was to prepare a comprehensive Biological Assessment of the effects of all NGB-authorized activities on San Joaquin kit fox (military training, anticipated construction projects, repair and maintenance activities, and all NGB-authorized non-military activities such as a hunting and fishing program, grazing leases, etc.). The program also provided NGB with the scientific expertise necessary to ensure compliance with the Endangered Species Act. The objective of this report is to summarize the progress and results of the Environmental Studies Program during Fiscal Years 1991 and 1992 (FY91/92).

27654 (LUNBDS-NBLI–93-1025) **Asellus and Gammarus spp. (Crustacea) in changing environments: effects of acid stress and habitat permanence.** Hargeby, A. Lund Univ. (Sweden). Dept. of Ecology. Mar 1993. 17 p.p. Order Number DE93500855. Source: OSTI; NTIS.

The research underlying this thesis included laboratory and field studies on how acid stress affects the benthic crustaceans Asellus aquaticus L. and Gammarus pulex (L.). A laboratory chamber was constructed to study growth and survival of G. pulex during acid stress. Low pH (6.0) caused 64-92% mortality within three weeks and reduced growth rate and food conversion efficiency in surviving animals. In a field experiment along a pH gradient, the mortality of G. pulex increased below pH 6. The whole-body content of sodium and potassium was reduced in surviving individuals, indicating osmoregulatory disturbance. In Asellus aquaticus, mortality was not affected by pH within the tested range (4.3-7.5). Laboratory experiments showed that interspecific interactions between A. aquaticus and G. pulex can include both exploitative competition and predation by G. pulex on A. aquaticus. Effects of seasonal habitat alterations was studied in a lake by comparing invertebrate assemblages associated with two species of submerged macroalgae (Characea), one perennial and one senescent during autumn. (28 refs.).

57 HEALTH AND SAFETY

Refer also to citation(s) 25855, 25922, 26266, 26406, 26419, 26420, 27266, 27369, 27610

27655 (ANL/EAIS/CP–79460) **A risk-based approach to cost-benefit analysis of software safety activities.** Fortier, S.C. (Intermetrics, Inc., McLean, VA (United States)); Michael, J.B. Argonne National Lab., IL (United States). [1993]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9306161–1: 8. annual conference on computer assurance, Gaithersburg, MD (United States), 14-17 Jun 1993). Order Number DE93012897. Source: OSTI; NTIS; GPO Dep.

Assumptions about the economics of making a system safe are usually not explicitly stated in industrial and software models of safety-critical systems. These assumptions span a wide spectrum of economic tradeoffs with respect to resources expended to make a system safe. The missing component in these models that is necessary for capturing the effect of economic tradeoffs is risk. A qualitative risk-based software safety model is proposed that combines features of industrial and software systems safety models. The risk-based model provides decision makers with a basis for performing cost-benefit analyses of software safety-related activities.

27656 (DOE–76-45/5-Rev.1) **Reported Significant Observation (RSO) studies: Revision 1.** Eicher, R.W. EG and G Idaho, Inc., Idaho Falls, ID (United States). System Safety Development Center. Dec 1992. 35p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. (SSDC–5-Rev.1). Order Number DE93013589. Source: OSTI; NTIS; GPO Dep.

The Reported Significant Observation (RSO) study used in the field of safety is an information-gathering technique where employee-participants describe situations they have personally witnessed involving good and bad practices and safe and unsafe conditions. This information is useful in the risk assessment process because it focuses on hazards and thereby facilitates their elimination. However, RSO cannot be the only component in a risk assessment program. Used by the Air Force in their aviation psychology program and further developed by John C. Flanagan, RSO is more commonly known as the "Critical Incident Technique." However, the words "Critical" and "Incident" had other connotations in nuclear safety, prompting early users within the Aerojet Nuclear Company to coin the more fitting title of "Reported Significant Observations." The technique spread slowly in the safety field primarily because the majority of users were researchers interested in after-the-fact data, with application to everyday problems and behavioral factors. RSO was formally recognized as a significant hazard reduction tool during the development of the Management Oversight and Risk Tree (MORT) program for the US Atomic Energy Commission. The Department of Energy (DOE) has, in turn, adopted MORT for its system safety program, and this has resulted in RSO being a modern and viable technique for DOE contractor safety programs.

27657 (DOE–76-45/13-Rev.1) **Management factors in accident and incident prevention (including management self-evaluation checklists): Revision 1.** Nertney, R.J. EG and G Idaho, Inc., Idaho Falls, ID (United States). System Safety Development Center. Feb 1993. 43p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. (SSDC–13-Rev.1). Order Number DE93013777. Source: OSTI; NTIS; GPO Dep.

Serious accidents and incidents occurring within the Department of Energy (DOE) will be investigated by committees including DOE trained investigators. A part of the investigation includes evaluation of management systems as they relate to the accident. The purpose of this guide is to outline, for general management, those management factors which have been found to be of importance in

accident prevention. These factors will, of course, will be studied by investigating teams. The management factors have been selected, through a ten-year, world-wide consensus process, as those which individually and collectively may represent accident/incident causal factors. It is the task of the investigating board or committee to determine which of these factors are, indeed, involved in a given accident or incident. Objectives of the guide are twofold: To provide a means for accident/incident prevention by familiarizing managers with the management-related accident/incident causal factors that have been revealed in accident investigation research. To help prepare line and project managers for the investigative process by making them aware of the factors that will be investigated.

27658 (DOE/CH/10324–T19) **Southern state radiological emergency preparedness and response agencies.** Southern States Energy Board, Norcross, GA (United States). Nov 1988. 60p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC01-87CH10324. Order Number DE93016316. Source: OSTI; NTIS; INIS; GPO Dep.

This Report provides information on the state agencies assigned to radioactive materials transportation incidents in 16 Southern States Energy Board member states. For each, the report lists the agencies with primary authority for preparedness and response, their responsibilities and personnel within the agencies who can offer additional information on their radioactive materials transportation programs. The report also lists each state's emergency team members and its laboratory and analytical capabilities. Finally, the governor's designee for receiving advance notification of high-level radioactive materials and spent fuel shipments under 10 CFR Parts 71 and 73 of the US Nuclear Regulatory Commission's regulations is listed for each state. Part 71 requires prenotification for large quantity radioactive waste shipments. Part 73 addresses prenotification for spent nuclear reactor fuel shipments.

27659 (EGG-M–93017) **Who's protecting you from hazardous substances?.** Perry, D.S. EG and G Idaho, Inc., Idaho Falls, ID (United States). [1993]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. (CONF-9303168–1: 1993 regional hazardous wastes and materials conference, Pacatello, ID (United States), 29-31 Mar 1993). Order Number DE93013667. Source: OSTI; NTIS; INIS; GPO Dep.

Employee accidents, life endangering spills of harmful chemicals, toxic materials leaching into drinking water, polluted air, crippling side effects of wonder metals and products, and human and animal deaths made it apparent that in order to protect and preserve the community and the environment, the community needed to be aware/knowledgeable of chemical uses and related possible dangers, i.e., it was time to establish rules and regulations for the use and disposal of hazardous substances and chemicals. This report details several organizations, acts, rules, and regulations created in the interest of hazardous materials safety.

27660 (EGG-M–93090) **Ergonomic assessments of three Idaho National Engineering Laboratory cafeterias.** Ostrom, L.T.; Romero, H.A.; Gilbert, B.G.; Wilhelmsen, C.A. EG and G Idaho, Inc., Idaho Falls, ID (United States). [1993]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. (CONF-9304143–1: Occupational ergonomic annual symposium, Lubbock, TX (United States), 16-17 Apr 1993). Order Number DE93013513. Source: OSTI; NTIS; GPO Dep.

The Idaho National Engineering Laboratory is a Department of Energy facility that performs a variety of engineering and research projects. EG&G Idaho is the prime contractor for the laboratory and, as such, performs the support functions in addition to technical, research, and development functions. As a part of the EG&G Idaho Industrial Hygiene Initiative, ergonomic assessments were conducted at three Idaho National Engineering Laboratory Cafeterias. The purposes of the assessments were to determine whether ergonomic problems existed in the work places and, if so, to make recommendations to improve the work place and task designs. The study showed there were ergonomic problems in all three cafeterias assessed. The primary ergonomic stresses observed included wrist and shoulder stress in the dish washing task, postural stress in the dish washing and food preparation tasks, and back stress in the food handling tasks.

27661 (RFP–4599) **Hydrogen peroxide safety issues.** Conner, W.V. EG and G Rocky Flats, Inc., Golden, CO (United States). Rocky Flats Plant. 14 Apr 1993. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC34-90DP62349. Order Number DE93013895. Source: OSTI; NTIS; INIS; GPO Dep.

A literature survey was conducted to review the safety issues involved in handling hydrogen peroxide solutions. Most of the information found in the literature is not directly applicable to conditions at the Rocky Flats Plant, but one report describes experimental work conducted previously at Rocky Flats to determine decomposition reaction-rate constants for hydrogen peroxide solutions. Data from this report were used to calculate decomposition half-life times for hydrogen peroxide in solutions containing several decomposition catalysts. The information developed from this survey indicates that hydrogen peroxide will undergo both homogeneous and heterogeneous decomposition. The rate of decomposition is affected by temperature and the presence of catalytic agents. Decomposition of hydrogen peroxide is catalyzed by alkalies, strong acids, platinum group and transition metals, and dissolved salts of transition metals. Depending upon conditions, the consequence of a hydrogen peroxide decomposition can range from slow evolution of oxygen gas to a vapor, phase detonation of hydrogen peroxide vapors.

5701 Real Accidents

Refer also to citation(s) 25672, 26164, 26166, 26356

58 GEOSCIENCES

Refer also to citation(s) 25580, 25584, 25593, 25597, 25610, 25682, 25728, 25729, 25753, 25754, 25756, 26030, 26274, 26340, 26848, 27226, 27258, 27260, 27392, 27413, 27414, 27415, 27416, 27417, 27418, 27419, 27420, 27421, 27423, 27424, 27425, 27439, 27446, 27452, 27464, 27478, 27483, 27484, 27485, 28154

27662 (DOE/ER/13749–4) **[Investigation of ultrasonic wave interaction with porous saturated rocks].** Ohio State Univ. Research Foundation, Columbus, OH (United States). Dept. of Welding Engineering. [1993]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-87ER13749. Order Number DE93016261. Source: OSTI; NTIS; GPO Dep.

During the last year we have continued our investigation of ultrasonic wave propagation in fluid-filled porous materials. Previously, we studied the feasibility of using different surface modes to characterize both synthetic and natural rocks. We introduced a novel experimental technique based on the direct generation of surface waves by edge excitation. At first, we used two low-frequency (100–500 kHz) shear transducers in pitch-catch mode to launch and receive the ultrasonic surface wave. The contact transducers were coupled to the opposite edges of the porous specimens with normal polarization relative to the surface. The same technique was successfully used to generate Rayleigh-type surface modes on the free surface of both dry and water-saturated specimens, as well as Stoneley-type interface modes on the fluid-loaded surfaces of immersed samples. Recently, we developed a special interferometric technique for non-contact detection of ultrasonic vibrations on diffusely reflecting rough surfaces. This method was found to be more suitable for surface wave inspection of porous ceramics and natural rocks than the previously used contact techniques. Beside investigating guided acoustic waves in water-saturated porous materials, we also studied bulk wave propagation in air-saturated specimens. We further developed our experimental technique which is based on the transmission of airborne ultrasonic waves through air-filled porous plates. This method can be readily used to study the frequency-dependent propagation properties of slow compressional waves in different porous materials including natural rocks. By simple technical improvements, we extended the measuring range so that we could continuously cover both low-frequency (diffuse) and high-frequency (propagating) regimes of slow wave propagation.

27663 (DOE/ER/14079–24) **Computational methods for improving the resolution of subsurface seismic images: Progress report, September 15, 1991–September 14, 1993.** Larner, K.; Hale, D.; Bleistein, N.; Cohen, J. Colorado School of

Mines, Golden, CO (United States). May 1993. 24p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-89ER14079. Order Number DE93015882. Source: OSTI; NTIS; GPO Dep.

Our interactive modeling for Gaussian beam modeling in two-dimensional, triangulated complex geologic structure, has been generalized to include transmission losses at interfaces, and density and Q-characterization of attenuation in layers. Also, multiple reflections and the option to model data from VSP acquisition geometry have been included. Shortcomings when the structure contains first-order discontinuities, however, limit the full geologic complexity that presently can be modeled by the Gaussian beam method. Other studies of wave filtering that arises for waves propagating nearly parallel to bedding reveal the importance of tunneling evanescent filtering on the propagating wavelet. Likewise, for reflections from steep interfaces, we have developed a dip-divergence correction to compensate for shortcomings in the conventional divergence correction for energy spreading. A new direction this past year, which we will be pursuing in the year ahead is analysis of errors in migration and dip-moveout (DMO) that arise when conventional imaging processing, which ignores anisotropy, is applied to data acquired where the subsurface is transversely isotropic. We are also developing approaches for taking anisotropy into account in these important imaging processes. Similarly, we have developed an efficient approach to performing DMO on P-SV-mode-converted data. Our interests in taking anisotropy into account have led us to study the importance of anisotropy in the overburden on reflection amplitude variations with offset (AVO).

27664 (DOE/FTR–93012692) **[Travel to New Zealand for studies in electromagnetic inversion applied to the earth and its relevance to environmental remediation]: Foreign trip report, August 23–September 12, 1992.** Newman, G.A. Sandia National Labs., Albuquerque, NM (United States). 14 Sep 1992. 23p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93012692. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Workshop sessions and field trips are described are described briefly. A list of participants is included.

27665 (DOE/ID/13042–6) **Impeller flow-meter logging of vertical cross flow between basalt aquifers through wells at the Idaho National Engineering Laboratory, Eastern Snake River Plain, Idaho: Progress report, June 22, 1992.** Bennecke, W.M.; Wood, S.H. Boise State Univ., ID (United States). Dept. of Geosciences. [1992]. 51p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG07-91ID13042. Order Number DE93012945. Source: OSTI; NTIS; INIS; GPO Dep.

An impeller flowmeter was used with a COLOG digital acquisition system to determine existing borehole flows, to compare with previous logging results, and to acquire flow measurements of vertical cross-flow of water in the wells between permeable zones in the open-hole intervals. The direction of flow found was predominantly downward with velocities ranging from 0-30 ft/min. Some flow reversals were noted and attributed to nearby pumping wells. USGS wells 44 and 46 were studied in September, 1991 near the Idaho Chemical Processing Plant (ICPP). The results showed a usual overall flow direction downward with flow entering the wells at around 510 to 600 ft. below the land surface. Water exited these wells at lower levels around 550 to 580 ft. Flow velocities ranged up to 24 ft/min. Using published aquifer parameters, the rate of propagation of a pressure change in an aquifer was calculated for the well CPP-2 turning on and off, at 3100 gpm.

27666 (IC–93/78) **Advanced criteria of seismic zoning and synthetic seismograms.** Panza, G.F. (International Centre for Theoretical Physics, Trieste (Italy)); Vaccari, F. International Centre for Theoretical Physics, Trieste (Italy). Apr 1993. [30p.] Contract CNR 91-02550-PF54;CNR 91-02539-PF54. Order Number DE93627954. Source: OSTI; NTIS (US Sales Only); INIS.

A brief revision of the traditional deterministic and probabilistic methods of first order seismic zonation, outlining their limits and possibilities, indicates that they can only lead to a kind of "post-event" zonation, which has a limited local validity. The strong influence of laterial heterogeneities and of source properties on the spatial distribution of Peak Ground Acceleration (PGA) and of the Total Energy of ground motion (W), indicates that the traditional methods require a deep revision. The method we have developed and applied to a first-order seismic zoning of the whole Italian territory and to the microzoning of specific objects, being based on the computation of synthetic seismograms, makes it possible and necessary to take source and propagation effects into account, fully utilizing the large amount of geological and geotechnical data, already available. Even though it falls in the domain of deterministic approaches, the method is very suitable for inclusion in the definition of new integrated procedures which combine probabilistic and deterministic approaches and allow us to minimize the present drawbacks which characterise the two methods when they are considered separately. If the seismotectonic regime is well known, a very important practical aspect of our deterministic approach is the immediate capability to direct the rescue intervention of the Civil Defence where the greatest damage is expected, by drawing post-event synthetic isoseismals for the source regions. Detailed modelling of ground motion for realistic two-dimensional media is a low-cost but very powerful tool for the prevention aspects of Civil Defence since it allows the computation of realistic seismic input for important structures based on the definition of a wide set of possible scenarios, which can be immediately used in the design of new seismo-resistant constructions and in the reinforcement of existing structures. (author). 65 refs, 14 figs.

27667 (LBL–33830) **Predicting the transport properties of sedimentary rocks from microgeometry.** Schlueter, E.M. Lawrence Berkeley Lab., CA (United States). Jan 1993. 85p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098 ;AC22-89BC14475. Order Number DE93015224. Source: OSTI; NTIS; GPO Dep.

We investigate through analysis and experiment how pore geometry, topology, and the physics and chemistry of mineral-fluid and fluid-fluid interactions affect the flow of fluids through consolidated/partially consolidated porous media. Our approach is to measure fluid permeability and electrical conductivity of rock samples using single and multiple fluid phases that can be frozen in place (wetting and nonwetting) over a range of pore pressures. These experiments are analyzed in terms of the microphysics and microchemistry of the processes involved to provide a theoretical basis for the macroscopic constitutive relationships between fluid-flow and geophysical properties that we develop. The purpose of these experiments and their analyses is to advance the understanding of the mechanisms and factors that control fluid transport in porous media. This understanding is important in characterizing porous media properties and heterogeneities before simulating and monitoring the progress of complex flow processes at the field scale in permeable media.

27668 (SAND–93-0823C) **Rapid acquisition of high resolution full wave-field borehole seismic data.** Sleefe, G.E. (Sandia National Labs., Albuquerque, NM (United States)); Harding, R.S. Jr.; Fairborn, J.W.; Paulsson, B.N.P. Sandia National Labs., Albuquerque, NM (United States). [1993]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-930901–2: Annual meeting of the Society of Exploration Geophysicists, Washington, DC (United States), 26-30 Sep 1993). Order Number DE93011667. Source: OSTI; NTIS; GPO Dep.

An essential requirement for both Vertical Seismic Profiling (VSP) and Cross-Hole Seismic Profiling (CHSP) is the rapid acquisition of high resolution borehole seismic data. Additionally, full wave-field recording using three-component receivers enables the use of both transmitted and reflected elastic wave events in the resulting seismic images of the subsurface. To this end, an advanced three- component multi-station borehole seismic receiver system has been designed and developed by Sandia National Laboratory (SNL) and OYO Geospace. The system requires data from multiple three-component wall-locking accelerometer packages and telemeters digital data to the surface in real-time. Due to the multiplicity of measurement stations and the real-time data link, acquisition time for the borehole seismic survey is significantly reduced. The system was tested at the Chevron La Habra Test Site using Chevron's clamped axial borehole vibrator as the seismic source. Several source and receiver fans were acquired using a four-station version of the advanced system. For comparison purposes, an equivalent

data set was acquired using a standard analog wall-locking geophone receiver. The test data indicate several enhancements provided by the multi-station receiver relative to the standard, drastically improved signal-to-noise ratio, increased signal bandwidth, the detection of multiple reflectors, and a true 4:1 reduction in survey time.

27669 (UCRL-JC–109870) **Exploratory data analysis on the Macintosh.** Grotch, S.L. Lawrence Livermore National Lab., CA (United States). Apr 1992. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9206372–1: 12. conference on probability and statistics in the atmospheric sciences, Ontario (Canada), 22-26 Jun 1992). Order Number DE93013043. Source: OSTI; NTIS; GPO Dep.

The past few years have seen a virtual revolution in computing, particularly in the area of small computers. For statistical and graphical data analysis, intense commercial competition has lead to the availability of a wide variety of general purpose statistical and graphical packages with extraordinary versatility and capabilities. This work will examine two of these currently available software systems as applied by the author to a variety of climate research tasks. This work is not an attempt to either provide an exhaustive survey or to rank available software as to "best," or to serve as an endorsement of any particular software, but rather to illustrate, through real examples, some of the power now available to the researcher through such software. For a more detailed, feature by feature intercomparison of several statistical packages, see two recent surveys: Seiter and Best and Moganstein. Attention here is focused on the Macintosh computer, primarily because of its wide availability and ease of interaction. Two packages that provide some particularly novel capabilities are illustrated: for statistics, Data Desk; and for graphics, Spyglass.

66 PHYSICS

27670 (SSCL-Preprint–209) **An ASD Physics Education Program.** Barton, H.R. Jr. Superconducting Super Collider Lab., Dallas, TX (United States). Apr 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930537–16: 5. annual international industrial symposium on the Super Collider and exhibition, San Francisco, CA (United States), 6-8 May 1993). Order Number DE93014131. Source: OSTI; NTIS; INIS; GPO Dep.

I want to thank the Organizing Committee and Program Chairman of the 1993 IISSC for providing this forum to discuss science education issues here in San Francisco. By all accounts, science education in the United States is in trouble. Clearly, teaching science to the young people of our country is an important goal shared by all of us involved in scientific research. The Director, Dr. Roy Schmitters, has made science education a Laboratory goal for the Supercollider. Those of us who share this goal only can have an impact if we become involved actively in teaching science to the future engineers and scientists enrolled at our colleges and universities. The commitment of IISSC to science education is welcomed by everyone of us who wishes to improve the technological base of the nation for the next generation.

6611 Classical and Quantum Mechanics

27671 (DOE/ER/40757–004) **The geometric phase in quantum physics.** Bohm, A. Texas Univ., Austin, TX (United States). Center for Particle Physics. Mar 1993. 64p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG03-93ER40757. (CONF-9206360–1: North Atlantic Treaty Organization (NATO)-ASI meeting on recent problems in mathematical physics, Salamanca (Spain), Jun 1992). Order Number DE93011121. Source: OSTI; NTIS; INIS; GPO Dep.

After an explanatory introduction, a quantum system in a classical time-dependent environment is discussed; an example is a magnetic moment in a classical magnetic field. At first, the general abelian case is discussed in the adiabatic approximation. Then the geometric phase for nonadiabatic change of the environment (Anandan–Aharonov phase) is introduced, and after that general cyclic (nonadiabatic) evolution is discussed. The mathematics of fiber bundles is introduced, and some of its results are used to describe the relation between the adiabatic Berry phase and the geometric phase for general cyclic evolution of a pure state. The discussion is restricted to the abelian, U(1) phase.

27672 (IC–93/43) **Steepest descent approximations for accretive operator equations.** Chidume, C.E. International Centre for Theoretical Physics, Trieste (Italy). Mar 1993. [19p.] Order Number DE93628586. Source: OSTI; NTIS (US Sales Only); INIS.

A necessary and sufficient condition is established for the strong convergence of the steepest descent approximation to a solution of equations involving quasi-accretive operators defined on a uniformly smooth Banach space. (author). 49 refs.

27673 (IC–93/54) **On a possible algebra morphism of $U_q[osp(1/2)]$ onto the deformed oscillator algebra $W_q(N)$.** Palev, T.D.; Stoilova, N.I. International Centre for Theoretical Physics, Trieste (Italy). Mar 1993. [8p.] Order Number DE93629857. Source: OSTI; NTIS (US Sales Only); INIS.

We formulate a conjecture, stating that the algebra of n pairs of deformed Bose creation and annihilation operators is a factor-algebra of $U_q[osp(1/2n)]$, considered as a Hopf algebra, and prove it for n=2 case. To this end we show that for any value of $qU_q[osp(1/4)]$ can be viewed as a superalgebra, freely generated by two pairs $B_1^{\pm}$, $B_2^{\pm}$ of deformed para-Bose operators. We write down all Hopf algebra relations, an analogue of the Cartan-Weyl basis, the "commutation" relations between the generators and a basis in $U_q[osp(1/2n)]$ entirely in terms of $B_1^{\pm}$, $B_2^{\pm}$. (author). 21 refs.

27674 (IC–93/72) **Global solutions to a system of strongly coupled reaction-diffusion equations.** Kirane, M. (International Centre for Theoretical Physics, Trieste (Italy)); Kouachi, S. International Centre for Theoretical Physics, Trieste (Italy). Apr 1993. [13p.] Order Number DE93628587. Source: OSTI; NTIS (US Sales Only); INIS.

The paper discusses the existence of globally bounded in time classical solutions for a system of strongly coupled reaction-diffusion equations under homogenous boundary conditions. 17 refs.

27675 (IC–93/79) **Distributively generated matrix near rings.** Abbasi, S.J. International Centre for Theoretical Physics, Trieste (Italy). Apr 1993. [4p.] Order Number DE93628588. Source: OSTI; NTIS (US Sales Only); INIS.

It is known that if R is a near ring with identity then (I,+) is abelian if (I^*,+) is abelian and (I,+) is abelian if (I^*,+) is abelian [S.J. Abbasi, J.D.P. Meldrum, 1991]. This paper extends these results. We show that if R is a distributively generated near ring with identity then (I,+) is included in Z(R), the center of R, if (I^*,+) is included in $Z(M_n(R))$, the center of matrix near ring $M_n(R)$. Furthermore (I,+) is included in Z(R) if (I^*,+) is included in $Z(M_n(R))$. (author). 5 refs.

27676 (IC–93/82) **Asymptotic behaviour of firmly non expansive sequences.** Rouhani, B.D. International Centre for Theoretical Physics, Trieste (Italy). Apr 1993. [11p.] Order Number DE93628589. Source: OSTI; NTIS (US Sales Only); INIS.

We introduce the notion of firmly non expansive sequences in a Banach space and present several results concerning their asymptotic behaviour extending previous results and giving an affirmative answer to an open question raised by S. Reich and I. Shafir. Applications to averaged mappings are also given. (author). 16 refs.

27677 (IC–93/93) **Quantum Heisenberg groups and Sklyanin algebras.** Andruskiewitsch, N. (Max-Planck-Inst. fuer Mathematik, Bonn (Germany)); Devoto, J.; Tiraboschi, A. International Centre for Theoretical Physics, Trieste (Italy). May 1993. [13p.] Order Number DE93628590. Source: OSTI; NTIS (US Sales Only); INIS.

We define new quantizations of the Heisenberg group by introducing new quantizations in the universal enveloping algebra of its Lie algebra. Matrix coefficients of the Stone-von Neumann representation are preserved by these new multiplications on the algebra of functions on the Heisenberg group. Some of the new quantizations provide also a new multiplication in the algebra of theta functions; we obtain in this way Sklyanin algebras. (author). 23 refs.

27678 (IC–93/96) **Fixed point iterations for strictly hemi-contractive maps in uniformly smooth Banach spaces.** Chidume, C.E.; Osilike, M.O. International Centre for Theoretical Physics, Trieste (Italy). May 1993. [14p.] Order Number DE93628591. Source: OSTI; NTIS (US Sales Only); INIS.

It is proved that the Mann iteration process converges strongly to the fixed point of a strictly hemi-contractive map in real uniformly smooth Banach spaces. The class of strictly hemi-contractive maps includes all strictly pseudo-contractive maps with nonempty fixed point sets. A related result deals with the Ishikawa iteration scheme when the mapping is Lipschitzian and strictly hemi-contractive. Our theorems generalize important known results. (author). 29 refs.

27679 (IC–93/97) **Steepest descent method for set-valued locally accretive mappings.** Chidume, C.E. International Centre for Theoretical Physics, Trieste (Italy). May 1993. [12p.] Order Number DE93628592. Source: OSTI; NTIS (US Sales Only); INIS.

Let E be a real q-uniformly smooth Banach space. Suppose T is a set-valued locally strongly accretive map with open domain D(T) in E and that 0 is an element of Tx has a solution x^* in D(T). Then there exists a neighbourhood B in D(T) of x^* and a real number $r_1>0$ such that for any $r>r_1$ and some real sequence $\{c_n\}$, any initial guess x_1 is an element of B and any single-valued selection T_0 of T, the sequence $\{x_n\}$ generated from x_1 by $x_{n+1}=x_n-c_nT_0x_n$, $n\geq 1$, remains in D(T) and converges strongly to x^* with ——x_n-x^*—— $O(n^{-(q-1)/q})$. A related result deals with iterative approximation of a solution of the equation f is an element of x+Ax when A is a locally accretive map. Our theorems generalize important known results and resolve a problem of interest. (author). 39 refs.

27680 (IC–93/100) **Self-sustained solitons in systems with nonlinear damping.** Gonzalez, J.A. International Centre for Theoretical Physics, Trieste (Italy). May 1993. [9p.] Order Number DE93628583. Source: OSTI; NTIS (US Sales Only); INIS.

The existence and stability of kinks in systems with nonlinear damping are investigated. We discuss the mechanism of a bifurcation after which the kink becomes a non-stationary state. (author). 9 refs.

27681 (IC–93/104) **Classical relativistic spinning particle with anomalous magnetic moment: The precession of spin.** Barut, A.O.; Cruz, M.G. International Centre for Theoretical Physics, Trieste (Italy). May 1993. [15p.] Order Number DE93628584. Source: OSTI; NTIS (US Sales Only); INIS.

The theory of classical relativistic spinning particles with c-number internal spinor variables, modelling accurately the Dirac electron, is generalized to particles with anomalous magnetic moments. The equations of motion are derived and the problem of spin precession is discussed and compared with other theories of spin. (author). 32 refs.

27682 (IC–93/106) **Diffraction and interference of single de Broglie-wavelets. Deterministic wave mechanics.** Barut, A.O. International Centre for Theoretical Physics, Trieste (Italy). May 1993. [16p.] Order Number DE93631750. Source: OSTI; NTIS (US Sales Only); INIS.

Wavelets are localized nonspreading solutions of massless wave equations which move like massive quantum particles. They form a bridge between classical mechanics of point particles and wave functions of probabilistic quantum mechanics, both of which can be obtained by limiting processes. Here we develop a theory of the propagation of wavelets in the presence of boundaries and derive interference phenomena of quantum theory from the behavior of single events with "hidden parameters". (author). 8 refs, 1 fig.

27683 (IC–93/108) **On a class of singular quasilinear elliptic equations with general structure and distribution data.** Le Dung. International Centre for Theoretical Physics, Trieste (Italy). May 1993. [25p.] Order Number DE93628585. Source: OSTI; NTIS (US Sales Only); INIS.

We present a $C^{1,\alpha}$ regularity theory for a large class of singular quasilinear elliptic equations having general structure and involving distribution data in some Campanato-Morrey spaces $M_{\lambda}{}^{-1,p'}$. An optimal equivalent relation between the regularity of weak solutions and the growth of data will be proved. The Holder continuity of solutions near the boundary is also given. Our results extend and complete those of Rakotoson and Ziemer. (author). 20 refs.

27684 (IFVE-OMVT–91-131) **About structurally stable generating mechanism for invariant hyperbolic sets.** Klimenko, S.V.; Smirnova, V.V. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov (Russian Federation). Inst. Fiziki Vysokikh Ehnergij. 1991. [19p.] (In Russian). Order Number DE93629858. Source: OSTI; NTIS (US Sales Only); INIS.

The given paper describes a generating mechanism for strange invariant sets. A method for finding structurally stable mechanism is presented. Attractors with this mechanism are pointed out. 11 refs.; 19 figs.

27685 (IHEP-OTF–91-190) **Path integrals on warped product manifolds.** Storchak, S.N. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov (Russian Federation). Inst. Fiziki Vysokikh Ehnergij. 1991. [7p.] Order Number DE93629859. Source: OSTI; NTIS (US Sales Only); INIS.

By reparametrizing the paths in a path integral, set on a warped product manifold, the integral relation between the Green's functions of quantum mechanical problems is derived describing the motion on the manifold as a whole on one of the submanifolds. 5 refs.

27686 (JINR-E–2-91-544) **Toroidal solenoids in the electromagnetic field and Aharonov-Casher effect.** Afanas'ev, G.N. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Theoretical Physics. 1991. [27p.] Order Number DE93629861. Source: OSTI; NTIS (US Sales Only); INIS.

Submitted to J. Phys., A.

The current toroidal configurations are found which generate gauge nonequivalent vector potentials and correspond to the same quantum scattering of charged particles. The equations for the motion of toroidal moment in the magnetic field are obtained. It is proved the existence of Aharonov-Casher effect for the toroidal solenoids. The relating experiments are proposed. 19 refs.; 7 figs.

27687 (JINR-E–2-91-551) **Deformed traces and covariant quantum algebras for quantum groups $GL_{qp}(2)$ and $GL_{qp}(1/1)$.** Isaev, A.P.; Malik, R.P. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Theoretical Physics. 1991. [10p.] Order Number DE93629862. Source: OSTI; NTIS (US Sales Only); INIS.

Submitted to Phys. Lett., B.

The q-deformed traces and orbits for the two parametric quantum groups $GL_{qp}(2)$ and $GP_{qp}(1/1)$ are defined which are subsequently used in the construction of q-orbit invariants for these groups. A general qp-(super)-oscillator commutation relations are obtained which remain invariant under the coactions of groups $GL_{qp}(2)$ and $GL_{qp}(1/1)$. The $GL_{qp}(2)$-covariant deformed algebra is deduced in terms of the bilinears of bosonic qp-oscillators which turns out to be a central extension of the Witten-type deformation of sl(2) algebra. 20 refs.

27688 (JINR-E–2-91-579) **Phase space representations and quantum probability theory.** Polubarinov, I.V. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Theoretical Physics. 1991. [20p.] Order Number DE93629863. Source: OSTI; NTIS (US Sales Only); INIS.

Phase space representations are constructed in quantum mechanics of spin 1. In these representations quantum mechanics and quantum probability theory acquire a similarity to the classical ones, however with essential distinctions. In some representations densities are not positive definite, in others densities are positive, but expectation values and other quantities are defined otherwise. For example, in the phase space representations the correlator of components of two spins 1 in the singlet state differs from its possible classical counterpart by extra numerical factors. This leads to the consistent quantum analogs of the Bell inequality. 24 refs.; 2 tabs.

27689 (JINR-E–2-92-171) **Paragrassmann analysis and quantum groups.** Filippov, A.T.; Isaev, A.P.; Kurdikov, A.B. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Theoretical Physics. 1992. [14p.] Order Number DE93628593. Source: OSTI; NTIS (US Sales Only); INIS.

Paragrassmann algebras with one and many paragrassmann variables are considered from the algebraic point of view without using the Green anzatz. A differential operator with respect to paragrassmann variable and a covariant para-super-derivative are introduced giving a natural generalization of the Grassmann calculus to a paragrassmann one. Deep relations between paragrassmann and quantum groups with deformation parameters being root of unity are established. 20 refs.

27690 (JINR-E–2-92-272) **Impulsive moving mirror model in a Schroedinger picture with impulse effect in a Banach space.** Petrov, G. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Theoretical Physics. 1992. [31p.] Order Number DE93629864. Source: OSTI; NTIS (US Sales Only); INIS.

From a special class of systems has been used a Schroedinger equation with impulse effect in Minkowski space field theory with time dependent boundary conditions, i.e. those of moving mirrors. The field theoretical approach for studing the properties of the vacuum starts from an analysis of the behaviour of local field quantities in Minkowski space with uniformly moving mirrors. For the impulsive moving mirror model is the real process of interaction between the quantum field and the external mirror a subject to disturbances in its evolution acting in time very short compared with the entire duration of the process. So the stability of the solution of the Schroedinger evolution equation for the process is the stability of the vacuum of Casimir. The dependence of vacuum state energy on the distance between the uniformly relatively moving mirrors is used to calculate from the impulsive moving model the Schroedinger equation in a Banach space. 21 refs.

27691 (JINR-E–2-92-274) **Asymptotic behaviour of the solutions of Schroedinger equation with impulse effect in a Banach space.** Bainov, D.D.; Kostadinov, S.I.; Petrov, G. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Theoretical Physics. 1992. [7p.] Order Number DE93629865. Source: OSTI; NTIS (US Sales Only); INIS.

The present paper studies the asymptotic behaviour of the solutions of linear homogeneous differential Schroedinger equation with impulse effect in a Banach space and finds a dependence between their asymptotic behaviour and the spectrum of the linear Hamiltonian operator. 6 refs.

27692 (JINR-E–2-92-275) **Impulsive moving mirror model and the stability of Schroedinger equation with impulse effect in a Banach space.** Kostadinov, S.I.; Petrov, G. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Theoretical Physics. 1992. [8p.] Order Number DE93629866. Source: OSTI; NTIS (US Sales Only); INIS.

From a special class of systems has been used a Schroedinger equation with impulse effect in Minkowski space field theory with time dependent boundary conditions, i.e. those of moving mirrors. The field theoretical approach for studying the properties of the vacuum starts from an analysis of the behaviour of local field quantities in Minkowski space with uniformly moving mirrors. For the impulsive moving mirror model is the real process of interaction between the quantum field and the external mirror a subject to disturbances in its evolution acting in time very short compared with the entire duration of the process. So the stability of the solution of the Schroedinger evolution equation for the process in the stability of the vacuum of Casimir. 8 refs.

27693 (JINR-E–2-92-276) **Impulsive moving mirror model and impulsive differential equations in Banach space.** Petrov, G. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Theoretical Physics. 1992. [14p.] Order Number DE93629867. Source: OSTI; NTIS (US Sales Only); INIS.

The dependence of vacuum state energy on the distance between the uniformly relatively moving mirrors is used to calculate impulsive differential equations in Banach space. We formulate the problem of moving mirrors, possibly with suddenly change of velocity v in $t=t_n$, n=0, 1, 2, ..., upon which quantum fields satisfy Dirichlet boundary conditions, with the associated Casimir effect, in a functional Schroedinger picture. 10 refs.

27694 (JINR-E–5-92-392) **On paragrassmann differential calculus.** Filippov, A.T.; Isaev, A.P.; Kurdikov, A.B. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Theoretical Physics. 1992. [16p.] Order Number DE93628594. Source: OSTI; NTIS (US Sales Only); INIS.

The paper significantly extends and generalizes our previous paper. Here we discuss explicit general constructions for paragrassmann calculus with one and many variables. For one variable nondegenerate differentiation algebras are identified and shown to be equivalent to the algebra of (p+1)x(p+1) complex matrices. For many variables we give a general construction of the differentiation algebras. Some particular examples are related to the multiparametric quantum deformations of the harmonic oscillators. 18 refs.

27695 (JINR-R–2-92-40) **Remarks on pair correlations of identical pions generated by extended sources.** Lyuboshits, V.L.; Podgoretskij, M.I. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of High Energy. 1992. [4p.] (In Russian). Order Number DE93629869. Source: OSTI; NTIS (US Sales Only); INIS.

Submitted to Yad. Fiz.

Two-particle correlations of identical pions with close momenta are discussed in the framework of the model with one-particle sources quantum-mechanically bound to definite points of space. The extent to each source is determined by the dependence of its wave function on displacement relative to corresponding 'central points'. It is shown that the refusal from the conception of hard fastened point sources leads to changing effective dimensions of the pion generation region. The considered model contains as limited situations two particular cases: hard fastened sources and free sources dispozed inside any space region. 1 ref.

27696 (JINR-R–2-92-302) **A hydrogen atom in the curved space. Expansion over free solutions on the three-dimensional sphere.** Vinitskij, S.I. (Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Theoretical Physics); Pogosyan, G.S.; Sisakyan, A.N.; Strizh, T.A.; Mardoyan, L.G. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Theoretical Physics. 1992. [18p.] (In Russian). Order Number DE93629868. Source: OSTI; NTIS (US Sales Only); INIS.

Submitted to Yad. Fiz.

The Schroedinger wave functions of the hydrogen atom with the harmonic potential are considered. The harmonic potential is the solution of the Laplace equation on the 3-sphere of radius R. For large R the wave functions correspond to the Coulomb wave functions of the hydrogen atom in the flat three-dimensional space. The decompositions of the Schroedinger wave functions in free solutions are constructed and their correspondence with the known expansions of the Coulomb functions over free ones in the three-dimensional space is established. 17 refs.; 5 figs.

27697 (LA-UR–93-1824) **The fractional quantum Hall effect and the spherical shell model.** Ginocchio, J.N. Los Alamos National Lab., NM (United States). [1993]. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9304152–1: From spectroscopy to chaos, Rochester, NY (United States), 17 Apr 1993). Order Number DE93014553. Source: OSTI; NTIS; INIS; GPO Dep.

We review the fractional quantum Hall effect in a spherical geometry and propose an ansatz for the many electron wavefunction which may explain the fractional quantum Hall effect.

27698 (UWThPh–1992-8) **Relative concavity of ground state energies as functions of a coupling constant.** Baumgartner, B. Vienna Univ. (Austria). Inst. fuer Theoretische Physik. 19 Mar 1992. [6p.] Order Number DE93628595. Source: OSTI; NTIS (US Sales Only); INIS.

Ground state energies of Hamiltonians in nonrelativistic quantum mechanics are analyzed with respect to their second derivative as functions of a coupling constant. In one-dimensional systems a comparison of two Hamiltonians yields relative convexity of the ground state energies as implications of a relative convexity of the potentials, by way of the relative log-concavity of the ground state wave functions. (author).

6612 Techniques of General Use in Physics

Refer also to citation(s) 26108, 26998, 27087, 27887, 27890, 28001

27699 (LA-UR-93-2415) **A recuperative superfluid stirling refrigerator.** Brisson, J.G.; Swift, G.W. Los Alamos National Lab., NM (United States). [1993]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930703-2: International cryogenic engineering conference and international cryogenic materials conference, Albuquerque, NM (United States), 12-16 Jul 1993). Order Number DE93016521. Source: OSTI; NTIS; GPO Dep.

A superfluid Stirling refrigerator has been built with a counterflow heat exchanger serving as a recuperative regenerator. It has achieved temperatures of 296 mK with a 4% ^{3}He-^{4}He mixture. Cooling power versus temperature and speed is presented for a 6.6% mixture.

27700 (UCRL-JC-113710) **EBIT Trapping Program.** Elliott, S.R. (Lawrence Livermore National Lab., CA (United States)); Beck, B.; Beiersdorfer, P.; DeWitt, D.; Knapp, D.K.; Marrs, R.E.; Schneider, D.; Church, D.; Schweikhard, L. Lawrence Livermore National Lab., CA (United States). 10 Mar 1993. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-930274-2: Workshop on traps for antimatter and radioactive nuclei, Vancouver (Canada), 25-27 Feb 1993). Order Number DE93014422. Source: OSTI; NTIS; GPO Dep.

Since its inception in 1986, the Electron Beam Ion Trap (EBIT) at LLNL has been used to produce and study highly charged ions up to U^{82+}. It has focused on the determination of electron-ion collision cross sections dielectronic recombination, electron-impact excitation, resonance excitation, and ionization as well as precise atomic structure models. The recent advance of SuperEBIT has extended the available ionization stages to bare U^{92+}. An extraction system allows us to perform experiments outside EBIT. This includes experiments in an external Penning trap under construction. Furthermore, current x-ray spectroscopic techniques will be supplemented by the future addition of a Fourier-Transform Ion Cyclotron Resonance (FT-ICR) mass spectrometry system. EBIT is geared to study not only a large variety of atomic physics but also nuclear physics phenomena, such as the bound state beta decay of fully stripped $^{163}Dy^{66+}$.

6613 Other Aspects of Physical Science

Refer also to citation(s) 27215, 27218, 27219, 27764, 27914, 28170, 28186

27701 (ANL/XFD/CP-79506) **A positron annihilation radiation telescope using Laue diffraction in a crystal lens.** Smither, R.K. (Argonne National Lab., IL (United States)); von Ballmoos, P. Argonne National Lab., IL (United States). Mar 1993. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9302114-1: International Gamma-ray Astrophysics Laboratory integral workshop, Les Diablerets (Switzerland), 2-5 Feb 1993). Order Number DE93012905. Source: OSTI; NTIS; INIS; GPO Dep.

We present a new type of gamma-ray telescope featuring a Laue diffraction lens, a detector module with a 3-by-3 germanium array, and a balloon gondola stabilized to 5 arc sec pointing accuracy. The instrument's lens is designed to collect 511 keV photons on its 150 CM^2 effective area and focus them onto a small detector having only $\approx$14 CM^3 of equivalent volume for background noise. As a result, this telescope overcomes the mass-sensitivity impasse of present detectors in which the collection areas are identical to the detection area. The sensitivity of our instrument is anticipated to be 3×10^{-5} ph cm^{-2} S^{-1} at 511 key with an angular resolution of 15 arc sec and an energy resolution of 2 keV. These features will allow the resolve of a possible energetically narrow 511 keV positron annihilation line both energy-wise and spatially within a Galactic Center "microquasar" as 1E1740.7-2942 or GRS1758-258. In addition to the galactic "microquasars," other prime objectives include Cyg X-1, X-ray binaries, pulsars, and AGNS.

27702 (FNAL/Pub-93-097-A) **Redshift distortions of galaxy correlation functions.** Fry, J.N. (Fermi National Accelerator Lab., Batavia, IL (United States)); Gaztanaga, E. Fermi National Accelerator Lab., Batavia, IL (United States). 12 May 1993. 30p. Sponsored by USDOE, Washington, DC (United States); National Aeronautics and Space Administration, Washington, DC (United States). DOE Contract AC02-76CH03000. Grant NAGW-2381. Order Number DE93014007. Source: OSTI; NTIS; INIS; GPO Dep.

To examine how peculiar velocities can affect the 2-, 3-, and 4-point correlation functions, we evaluate volume-average correlations for configurations that emphasize and minimize distortions for four different volume-limited samples from each of the CfA, SSRS, and IRAS redshift catalogs. We present the results as the correlation length r_0 and power index γ of the 2-point correlation, $\bar{\xi}_2 = (r_0/r)^\gamma$, and as the hierarchical amplitudes of the 3- and 4-point functions, $S_3 = \bar{\xi}_3/\bar{\xi}_2^2$ and $S_4 = \bar{\xi}/\bar{\xi}_2^3$. We find a characteristic distortion for $\bar{\xi}_2$: The slope γ is flatter and the correlation length is larger in redshift space than in real space; that is, redshift distortions "move" correlations from small to large scales. At the largest scales, extra power in the redshift distribution is compatible with $\Omega^{4/7}/b \approx 1$; we find 0.53 ± 0.15, 1.10 ± 0.16 and 0.84 ± 0.45 for the CfA, SSRS and IRAS catalogs. Higher order correlations $\bar{\xi}_3$ and $\bar{\xi}_4$ suffer similar redshift distortions, but in such a way that, within the accuracy of our analysis, the normalized amplitudes S_3 and S_4 are insensitive to this effect. The hierarchical amplitudes S_3 and S_4 are constant as a function of scale between 1-12 h^{-1} Mpc and have similar values in all samples and catalogues, $S_3 \approx 2$ and $S_4 \approx 6$, despite the fact that $\bar{\xi}_2$, $\bar{\xi}_3$, and $\bar{\xi}_4$ differ from one sample to another by large factors. The agreement between the independent estimations of S_3 and S_4 is remarkable given the different criteria in the selection of galaxies and also the difference in the resulting range of densities, luminosities and locations between samples.

27703 (IC-93/45) **A physical model for one-dimension and time-dependent ionosphere - Pt. 1: Description of the model.** Zhang Shunrong (International Centre for Theoretical Physics, Trieste (Italy)); Radicella, S.M.; Huang, Xinyu; Su Yuanzhi. International Centre for Theoretical Physics, Trieste (Italy). Mar 1993. [9p.] Order Number DE93627958. Source: OSTI; NTIS (US Sales Only); INIS.

On the basis of continuity and momentum equations for the ionospheric F region, a time-dependent and one-dimension model for O^+, N_2^+, O_2^+, and NO^+, taking into account photoionization production, 10 recombination reactions, thermospheric wind and electromagnetic drifts, have been derived. The bottom side boundary is set to be dominated by photo-chemical reactions, meanwhile, the top side can be influenced by other processes. Electron density, especially foF_2, or flux can be given as input. The present model can be used for the investigation of the influence of different parameters on the ionospheric processes, such as neutral wind, solar radiation flux, electromagnetic forces, and others. Part 1 gives the description of the model. Numerical results and its physical discussions will be addressed in the next paper. (author). 13 refs.

27704 (IC-93/46) **A physical model for one-dimension and time-dependent ionosphere - Pt. 2: Results and discussions.** Zhang Shunrong; Radicella, S.M. International Centre for Theoretical Physics, Trieste (Italy). Mar 1993. [16p.] Order Number DE93627959. Source: OSTI; NTIS (US Sales Only); INIS.

Results of a one-dimension time-dependent ionospheric theoretical model when experimental critical frequency of the F_2 region are used as input data are given. Evidences of the validity of the mentioned model are shown; and it is indicated that the bottom side F region described by IRI90 empirical model for Wuchang (30.5^0N, 11.4^0E) are well reproduced by the theoretical model for different seasons and low solar activity, meanwhile, it is shown that IRI gives values of the electron concentration in the topside larger than the model. Also, the effect of the dynamics and the photoionization on the variation of the height of the peak is discussed. (author). 5 refs, 8 figs.

27705 (IC-93/67) **A lattice gas model on a tangled chain.** Mejdani, R. International Centre for Theoretical Physics, Trieste (Italy). Apr 1993. [25p.] Order Number DE93629888. Source: OSTI; NTIS (US Sales Only); INIS.

We have used a model of a lattice gas defined on a tangled chain to study the enzyme kinetics by a modified transfer matrix method. By using a simple iterative algorithm we have obtained different kinds of saturation curves for different configurations of the tangled chain and different types of the additional interactions. In

some special cases of configurations and interactions we have found the same equations for the saturation curves, which we have obtained before studying the lattice gas model with nearest neighbor interactions or the lattice gas model with alternate nearest neighbor interactions, using different techniques as the correlated walks' theory, the partition point technique or the transfer matrix model. This more general model and the new results could be useful for the experimental investigations. (author). 20 refs, 6 figs.

27706 (IC–93/75) **Binary pulsar PSR 1718-19 contains a stripped main-sequence turn-off star.** Zwitter, T. International Centre for Theoretical Physics, Trieste (Italy). May 1993. [5p.] Order Number DE93631800. Source: OSTI; NTIS (US Sales Only); INIS.

Lyne et al. (1993) have recently announced the discovery of a 1-second globular cluster pulsar, 1718-19, in a 6.2-hour binary system which is embedded in a cloud of material originating from the companion star. However the incident flux of the pulsar's radiation on the companion is too low to ablate it and a main sequence companion is too small to fill its Roche lobe. Here I argue that the companion is a stripped turn-off star of 0.2-0.4 solar masses (M_{sun}) and with approx. $0.1M_{sun}$ helium core. It has approx. 1.8-times larger radius than a main sequence star of equal mass. Its position in the Hertzsprung-Russell diagram overlaps that of a $\approx 0.65M_{sun}$ main-sequence star. The evolutionary state of the companion and the highly magnetized slowly rotating neutron star place the system on the verge of the low mass X-ray binary phase. (author). 19 refs, 2 figs.

27707 (IC–93/110) **Life in the universe: Towards an understanding of its origin.** Chela-Flores, J. International Centre for Theoretical Physics, Trieste (Italy). May 1993. [25p.] Order Number DE93631799. Source: OSTI; NTIS (US Sales Only); INIS.

A general review is presented in which we select some aspects of the origin of the cosmos, chemical evolution and, finally, the origin and the evolution of life on Earth. We emphasize the topic of molecular relics with particular attention to the relevance of the chirality of amino acids and nucleic acids. We conclude with a discussion of the primordial RNA world and with some preliminary ideas on the question of whether it is possible to detect relics of the RNA world, other than chirality itself. (author). 27 refs, 4 figs, 2 tabs.

27708 (JINR-R–14-92-321) **Toroid excitation of nuclear magnetic resonance.** Dubovik, V.M. (Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Theoretical Physics); Lunegov, I.V.; Martsenyuk, M.A. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Theoretical Physics. 1992. [16p.] (In Russian). Order Number DE93629889. Source: OSTI; NTIS (US Sales Only); INIS.

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Some new approach in the NMR spectroscopy is discussed by which one can investigate a space distribution of nuclear spins and observe a 'forbidden' transition in the energy spectrum. It is based on the possibility of bringing about the transitions by vertex vector field interacting with the toroid moment of a spin system. 8 refs.; 3 figs.

27709 (LA-UR–93-1159) **Evolution of the interplanetary magnetic field.** McComas, D.J. Los Alamos National Lab., NM (United States). [1993]. 42p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9302115–2: AGU monograph/solar system plasma physics meeting on resolution of processes in space and time, Yosemite, CA (United States), Feb 1993). Order Number DE93012631. Source: OSTI; NTIS; GPO Dep.

Remote observations of magnetic field topologies in the solar corona and in situ observations of the solar wind and interplanetary magnetic field (IMF) in interplanetary space are used to examine the temporal evolution of the spatial distribution of open and closed field regions emanating from the Sun. The simple "open" configuration of inward and outward pointing sectors in the IMF is periodically disrupted by magnetically distinct coronal mass ejections (CMEs) which erupt from previously closed magnetic field regions in the corona into interplanetary space. At 1 AU, CMEs contain counterstreaming halo electrons which indicate their distinct magnetic topologies. This topology is generally thought to be: plasmoids that are completely disconnected from the Sun; magnetic "bottles," still tied to the corona at both ends; or flux ropes which are only partially disconnected. Fully disconnected plasmoids would have no long term effect on the amount of open flux; however, both in situ observations of details of the halo electron distributions and remote coronagraph observations of radial fields following CMEs indicate that CMEs generally do retain at least partial attached to the Sun. Both the magnetic-bottle and flux rope geometries require some mitigating process to close off previously open fields in order to avoid a flux catastrophe. In addition, the average amount of magnetic flux observed in interplanetary space varies over the solar cycle, also indicating that there must be ways in which new flux is opened and previously open flux is closed off. The most likely scenario for closing off open magnetic fields is for reconnection to occurs above helmet streamers, where oppositely directed field regions are juxtaposed in the corona. These events would serve to return closed field arches to the Sun and release open, U-shaped structures into the solar wind.

27710 (LA-UR–93-1508) **Advances in low energy neutral atom imaging techniques.** Scime, E.E. (Los Alamos National Lab., NM (United States)); Funsten, H.O.; McComas, D.J.; Moore, K.R.; Gruntman, M. Los Alamos National Lab., NM (United States). [1993]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930722–2: Annual meeting of the Society of Photo-Optical Instrumentation Engineers, San Diego, CA (United States), 11-16 Jul 1993). Order Number DE93012745. Source: OSTI; NTIS; GPO Dep.

Recently proposed low energy neutral atom (LENA) imaging techniques use a collisional process to convert the low energy neutrals into ions before detection. At low energies, collisional processes limit the angular resolution and conversion efficiencies of these devices. However, if the intense ultraviolet light background can be suppressed, direct LENA detection is possible. We present results from a series of experiments designed to develop a novel filtering structure based on free-standing transmission gratings. If the grating period is sufficiently small, free standing transmission gratings can be employed to substantially polarize ultraviolet (UV) light in the wavelength range 300 Å to 1500 Å. If a second grating is placed behind the first grating with its axis of polarization oriented at a right angle to the first's, a substantial attenuation of UV radiation is achievable. ne neutrals will pass through the remaining open area of two gratings and be detected without UV background complications. We have obtained nominal 2000 Å period (1000 Å bars with 1000 Å slits) free standing, gold transmission gratings and measured their UV and atomic transmission characteristics. The geometric factor of a LENA imager based on this technology is comparable to that of other proposed LENA imagers. In addition, this of imager does not distort the neutral trajectories, allowing for high angular resolution.

27711 (LA-UR–93-1509) **Low energy neutral atom imaging techniques.** Funsten, H.O. McComas, D.J.; Scime, E.E. Los Alamos National Lab., NM (United States). 1993. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930722–1: Annual meeting of the Society of Photo-Optical Instrumentation Engineers, San Diego, CA (United States), 11-16 Jul 1993). Order Number DE93012744. Source: OSTI; NTIS; GPO Dep.

The potential scientific return from low energy neutral atom (LENA) imaging of the magnetosphere is extraordinary. The technical challenges of LENA detection include (1) removal of LENAs from the tremendous ambient UV without losing information of their incident trajectories, (2) quantification of their trajectories, and (3) obtaining high sensitivity measurements. Two techniques that have been proposed for this purpose are based on fundamentally different atomic interaction mechanisms between LENAs and a solid: LENA transmission through an ultrathin foil and LENA reflection from a solid surface. Both of these methods provide LENA ionization (for subsequent removal from the UV by electrostatic deflection) and secondary electron emission (for start pulse generation for time-of-flight and/or coincidence). We present a comparative study of the transmission and reflection techniques

based on differences in atomic interactions with solids and surfaces. We show that transmission methods yield an order of magnitude greater secondary electron emission than reflection methods. Transmission methods are shown to be sufficient for LENA energies of approximately 1 keV to greater than 30 keV. Reflection methods using low work function surfaces could be employed for LENA ionization for energies less than several keV.

27712 (LA-UR–93-1601) **Search for continuous and single day emission from ultra-high-energy sources.** Chen, Mei-Li. The CYGNUS Collaboration. Los Alamos National Lab., NM (United States). [1993]. 5p. Sponsored by USDOE, Washington, DC (United States); National Science Foundation, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930779–11: International cosmic-ray conference, Calgary (Canada), 19-20 Jul 1993). Order Number DE93012724. Source: OSTI; NTIS; INIS; GPO Dep.

Data from the CYGNUS experiment has been used to search the northern sky for point sources of continuous ultra-high-energy gamma radiation and to examine 51 candidate sources on a daily basis to search for episodic emission. In this paper, we make use of our most recent data to update our previously published results from these searches. The data sample is approximately twice as large as the published data set for continuous emission, and contains an additional year for the daily search. The latest results, up to the time of the conference, will be presented at the meeting.

27713 (LA-UR–93-1602) **Angular resolution studies of the CYGNUS array using the shadows of the sun and moon.** Shoup, A.L. The CYGNUS Collaboration. Los Alamos National Lab., NM (United States). [1993]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930779–2: International cosmic-ray conference, Calgary (Canada), 19-20 Jul 1993). Order Number DE93012723. Source: OSTI; NTIS; GPO Dep.

Using the cosmic ray shadows of the sun and moon, we have estimated the angular resolution of the CYGNUS extensive air shower array. With the event sample now available we estimate the angular resolution of the array to be $0.70_{-0.06}{}^{+0.07}$ degrees. The resolution depends on the total number of detected shower particles. A new parameterization of the measured shower-front timing structure and the use of counters with small pulse areas lead to a ~25% improvement in the resolution. The systematic pointing error of the array is less than 0.4°.

27714 (LA-UR–93-1604) **Search for ultra-high-energy radiation from γ-ray bursts.** Schnee, R.W. The CYGNUS Collaboration. Los Alamos National Lab., NM (United States). [1993]. 5p. Sponsored by USDOE, Washington, DC (United States); National Science Foundation, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930779–10: International cosmic-ray conference, Calgary (Canada), 19-20 Jul 1993). Order Number DE93012721. Source: OSTI; NTIS; INIS; GPO Dep.

Using data from the CYGNUS extensive air shower array, we have searched for evidence of emission of ultra-high-energy radiation coincident with γ-ray bursts observed by the BATSE instrument on the Compton Gamma-Ray Observatory. No statistically significant excess was found for any point in the sky within 4σ of BATSE's best location coordinates for any of the 56 bursts examined. Furthermore, no events were seen in the 2.2° radius circular bin surrounding γ-ray burst GRB 920720, whose location was determined accurately by the Compton/Ulysses/PVO Interplanetary Network of satellites. Flux upper limits depend greatly on the actual zenith angle of the burst. Typical fluence upper limits above 100 TeV are $\sim 10^{-6}$ erg cm^{-2}. The fluence upper limits for GRB 920720 is 2×10^{-6} erg cm^{-2}.

27715 (LA-UR–93-1606) **Search for emission of ultra high energy radiation from active galactic nuclei.** The CYGNUS Collaboration. Los Alamos National Lab., NM (United States). [1993]. 5p. Sponsored by USDOE, Washington, DC (United States); National Science Foundation, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930779–7: International cosmic-ray conference, Calgary (Canada), 19-20 Jul 1993). Order Number DE93012719. Source: OSTI; NTIS; INIS; GPO Dep.

A search for emission of ultra-high energy gamma radiation from 13 active galactic nuclei that were detected by EGRET, using the CYGNUS extensive air-shower array, is described. The data set has been searched for continuous emission, emission on the time scale of one week, and for on the time scale of out day. No evidence for emission from any of the AGN on any of the time scales examined was found. The 90% C.L. upper limit to the continuous flux from Mrk 421 above 50 TeV is 7.5×10^{-14} cm^{-2}s^{-1}.

27716 (LA-UR–93-1607) **Search for UHE point-source emission over various time scales.** The CYGNUS Collaboration. Los Alamos National Lab., NM (United States). [1993]. 4p. Sponsored by USDOE, Washington, DC (United States); National Science Foundation, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930779–3: International cosmic-ray conference, Calgary (Canada), 19-20 Jul 1993). Order Number DE93012718. Source: OSTI; NTIS; GPO Dep.

A method has been developed to search for pulsed and/or unpulsed ultra high energy (UHE) emission from point sources over a range of time scales. This method has been applied to data accumulated with the CYGNUS extensive air-shower array for events associated with the directions of Cyg X-3, Her X-1, the Crab nebula, and a collection of 48 secondary source candidates. An examination of time scales ranging from minutes to years has yielded results consistent with background fluctuations.

27717 (LA-UR–93-1732) **A classical instability for black strings and p-branes.** Gregory, R. (Chicago Univ., IL (United States). Enrico Fermi Inst.); Laflamme, R. Los Alamos National Lab., NM (United States). [1993]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9305199–1: Gravity and relativistic astrophysics, Waterloo (Canada), 13-15 May 1993). Order Number DE93014577. Source: OSTI; NTIS; GPO Dep.

We investigate the evolution of small perturbations around black of strings and branes which are low energy solutions of string theory. For simplicity we focus attention on the zero charge case and show that there are unstable modes for a range of time frequency and wavelength in the extra 10 - D dimensions. These perturbations can be stabilized if the extra dimensions are compactified to a scale smaller than the minimum wavelength for which instability occurs and thus will not affect large astrophysical black holes in four dimensions. We comment on the implications of this result for the Cosmic Censorship Hypothesis.

27718 (LA-UR–93-1798) **Terrestrial magnetospheric imaging: Numerical modeling of low energy neutral atoms.** Moore, K.R.; Funsten, H.O.; McComas, D.J.; Scime, E.E.; Thomsen, M.F. Los Alamos National Lab., NM (United States). [1993]. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Contract F19628-90-K-0012;Grant NAGW-1655. (CONF-930722–3: Annual meeting of the Society of Photo-Optical Instrumentation Engineers, San Diego, CA (United States), 11-16 Jul 1993). Order Number DE93014561. Source: OSTI; NTIS; INIS; GPO Dep.

Imaging of the terrestrial magnetosphere can be performed by detection of low energy neutral atoms (LENAs) that are produced by charge exchange between magnetospheric plasma ions and cold neutral atoms of the Earth's geocorona. As a result of recent instrumentation advances it is now feasible to make energy-resolved measurements of LENAs from less than I key to greater than 30 key. To model expected LENA fluxes at a spacecraft, we initially used a simplistic, spherically symmetric magnetospheric plasma model.[6] We now present improved calculations of both hydrogen and oxygen line-of-sight LENA fluxes expected on orbit for various plasma regimes as predicted by the Rice University Magnetospheric Specification Model. We also estimate expected image count rates based on realistic instrument geometric factors, energy passbands, and image accumulation intervals. The results indicate that presently proposed LENA instruments are capable of imaging of storm time ring current and potentially even quiet time ring current fluxes, and that phenomena such as ion injections from the tail and subsequent drifts toward the dayside magnetopause may also be deduced.

27719 (LA-UR–93-1968) **Discussion of stress tensor nonuniqueness with application to nonuniform, particulate systems.** Aidun, J.B. Los Alamos National Lab., NM (United States). [1993]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9306167–1: 14. international conference on high pressure science and technology and 1993 technical meeting of the topical group on shock compression of condensed matter, Colorado Springs, CO (United States), 28 Jun - 3 jul 1993). Order Number DE93014352. Source: OSTI; NTIS; GPO Dep.

The indeterminacy of the mechanical stress tensor has been noted in several developments of expressions for stress in a system of particles. It is generally agreed that physical quantities related to the stress tensor must be insensitive to this nonuniqueness, but there is no definitive prescription for insuring it. Kroener's tensor decomposition theorem is applied to the mechanical stress tensor σ_{ij} to show that its complete determination requires specification of its "incompatibility," $\epsilon_{ijk}\,\epsilon_{lmn}\,\partial_j\,\partial_m\,\sigma_{kn}$, in addition to its divergence, which is obtained from the momentum conservation relation. For a particulate system, stress tensor incompatibility is shown to vanish to recover the correct expression for macroscopically observable traction. This result removes concern about nonuniqueness without requiring equilibrium or arbitrarily-defined force lines.

27720 (LA-UR–93-2371) **The Solar Flare Myth in solar-terrestrial physics.** Gosling, J.T. Los Alamos National Lab., NM (United States). 1993. 15p. Sponsored by USDOE, Washington, DC (United States); National Aeronautics and Space Administration, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9302115–4: AGU monograph/solar system plasma physics meeting on resolution of processes in space and time, Yosemite, CA (United States), Feb 1993). Order Number DE93016487. Source: OSTI; NTIS; GPO Dep.

Early observations of associations between solar flares and large non- recurrent geomagnetic storms, large 'solar' energetic particle events, and transient shock wave disturbances in the solar wind led to a paradigm of cause and effect that gave flares a central position in the chain of events leading from solar activity to major transient disturbances in the near-earth space environment. However, research in the last two decades shows that this emphasis on flares is misplaced. In this paper the author outlines briefly the rationale for a different paradigm of cause and effect in solar- terrestrial physics that removes solar flares from their central position as the 'cause' of major disturbances in the near-earth space environment. Instead, this central role of 'cause' is played by events now known as coronal mass ejections, or CMEs.

27721 (LA-UR–93-2390) **Statistical mechanical theory of liquid entropy.** Wallace, D.C. Los Alamos National Lab., NM (United States). [1993]. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930680–1: 1. congress of the International Society for Theoretical Chemistry and Physics, Gerona (Spain), 28 Jun - 3 jul 1993). Order Number DE93016524. Source: OSTI; NTIS; INIS; GPO Dep.

The multiparticle correlation expansion for the entropy of a classical monatomic liquid is presented. This entropy expresses the physical picture in which there is no free particle motion, but rather, each atom moves within a cage formed by its neighbors. The liquid expansion, including only pair correlations, gives an excellent account of the experimental entropy of most liquid metals, of liquid argon, and the hard sphere liquid. The pair correlation entropy is well approximated by a universal function of temperature. Higher order correlation entropy, due to n-particle irreducible correlations for $n \geq 3$, is significant in only a few liquid metals, and its occurrence suggests the presence of n-body forces. When the liquid theory is applied to the study of melting, the author discovers the important classification of normal and anomalous melting, according to whether there is not or is a significant change in the electronic structure upon melting, and he discovers the universal disordering entropy for melting of a monatomic crystal. Interesting directions for future research are: extension to include orientational correlations of molecules, theoretical calculation of the entropy of water, application to the entropy of the amorphous state, and correlational entropy of compressed argon. The author clarifies the relation among different entropy expansions in the recent literature.

27722 (LBL–33771) **Fast pulsars, compact stars, and the strange matter hypothesis.** Weber, F. (Muenchen Univ. (Germany). Inst. fuer Theoretische Physik); Glendenning, N.K. Lawrence Berkeley Lab., CA (United States). 17 Mar 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-9301109–3: 2. international conference on physics and astrophysics of quark-gluon plasma, Calcutta (India), 19-23 Jan 1993). Order Number DE93015039. Source: OSTI; NTIS; INIS; GPO Dep.

Part one of this paper deals with the recent finding of the possible existence of a mixed phase of baryon matter and quark matter inside neutron stars. In part two we review the theoretically determined minimum rotational periods of neutron stars, which serve to distinguish between pulsars that can be understood as rotating neutron stars and those that can not. Likely candidates for the latter are hypothetical strange stars. Their mass-radius relationship is discussed in the last part. It is pointed out that strange stars with a nuclear crust can give rise to the observed phenomena of pulsar glitches, thus passing the only astrophysical test of the strange-matter hypothesis existing to date.

27723 (SAND–92-1967) **Ionospheric effects on a wide-bandwidth, polarimetric, space-based, synthetic-aperture radar.** Brock, B.C. Sandia National Labs., Albuquerque, NM (United States). Jan 1993. 67p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93015084. Source: OSTI; NTIS; GPO Dep.

The earth's ionosphere consists of an ionized plasma which will interact with any electromagnetic wave propagating through it. The interaction is particularly strong at vhf and uhf frequencies but decreases for higher microwave frequencies. These interaction effects and their relationship to the operation of a wide-bandwidth, synthetic-aperture, space-based radar are examined. Emphasis is placed on the dispersion effects and the polarimetric effects. Results show that high-resolution (wide-bandwidth) and high-quality coherent polarimetrics will be very difficult to achieve below 1 GHz.

27724 (SAND–92-2240C) **Predicting the vibrations of a spinning inflated membrane.** Segalman, D.J.; Slavin, A. Sandia National Labs., Albuquerque, NM (United States). [1993]. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9309116–2: Conference on vibration and noise, Albuquerque, NM (United States), 20-22 Sep 1993). Order Number DE93010690. Source: OSTI; NTIS; GPO Dep.

The primary difficulty of computing the vibration of spinning inflated membranes arises from the low natural frequencies of such systems. When such systems are rotated near their own natural frequencies the dynamics equations must account for higher order kinematics than is necessary for more rigid structures. These complications results from the membrane loads that develop within the bodies in reaction to the accelerations of the overall body. When second order kinematics act against these membrane loads, the resulting energies become of the same order as the potential and kinetic energies of the vibrations that would be calculated by first order kinematics. These complications apply to the problem addressed here. Here we consider a spin-stabilized, inflated membrane, spinning around its minor axis. This structure is very flexible and somewhat viscoelastic, so vibrations excited by the overall motion of the structure will dissipate energy of the system, thus reducing the kinetic energy. A reduction in kinetic energy consistent with a conservation of angular momentum results in coning and, eventually, tumbling. Here we must address the excitation of vibration by the rigid-body motion and then we must address the retarding effect of the energy dissipation on the rigid-body motion.

27725 (UCRL-JC–111448) **Charge-exchange reactions and weak interaction rates for Type II supernovae.** Aufderheide, M.B. Lawrence Livermore National Lab., CA (United States). Dec 1992. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9209239–6: Workshop on nuclear physics in the universe, Oak Ridge, TN (United States), 24-26 Sep 1992). Order Number DE93015104. Source: OSTI; NTIS; GPO Dep.

The role of weak interactions, such as electron capture and beta decay on fp shell nuclei, during presupernova evolution of massive

stars is examined. The utility of charge-exchange experiments for calibrating these rates is discussed. Recent (n,p) measurements indicate that the presently used rates need to be recalculated because the location of the Gamow-Teller resonances which dominate the rates in the presupernova environment could not be accurately determined. How these measurements allow us to calibrate our shell model calculations, and thus these rates, is explained. The general character of beta decay rates in this environment is then examined. It is shown that the creation and destruction rates for electrons appear to balance just after core silicon burning. A one zone model is used to examine how the beta decays will affect the evolution of the electron number and entropy. The consequences for collapse models are briefly examined.

27726 (UCRL-JC–111689) **On inhomogeneous halo collapse and the globular cluster metallicity gradient.** Hartmann, D. (Clemson Univ., SC (United States). Dept. of Physics and Astronomy); Miller, N.; Mathews, G.; Malinie, G. Lawrence Livermore National Lab., CA (United States). Sep 1992. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9207198–1: Santa Cruz workshop on the galaxy – globular cluster connection, Santa Cruz, CA (United States), Jul 1992). Order Number DE93013090. Source: OSTI; NTIS; GPO Dep.

Globular cluster systems hold vital information on the formation and early evolution of galaxies. In particular, any correlation between kinematics and composition might allow us to probe the most active periods of galactic chemo-dynamics (GCD). Using the detailed observations of the Galactic globular cluster system, we study GCD of the Galactic halo. Assuming that the sub-class of halo globulars traces the star formation history of the halo, we investigate the chemical evolution of a collapsing, centrally condensed proto-galaxy. The absence of a strong radial metallicity gradient is used to test inhomogeneous models. We find that violent relaxation and supernova heating wash out the metallicity gradient established during the collapse. Following cluster orbits during collapse, when the potential changes rapidly, and in a static potential thereafter, we find a very small present-day metallicity gradient, consistent with the observations.

27727 (UCRL-JC–111860) **Wind mass and energy deposition.** Castor, J.I. Lawrence Livermore National Lab., CA (United States). 21 Sep 1992. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9206370–1: 104. annual meeting of the Astronomical Society of the Pacific, Madison, WI (United States), 20-25 Jun 1992). Order Number DE93013345. Source: OSTI; NTIS; GPO Dep.

The subject of mass return to the interstellar medium by the winds of massive stars is reviewed from the viewpoint of calculations of stellar evolution with mass loss, combined with the birth rate function for stars of different masses (IMF). The uncertainties due to the IMF and in the assumed mass loss rates are discussed. The corresponding energy deposition rates from stellar winds are also estimated.

27728 (UCRL-JC–111951) **Acousto-optical confirmation of the localized wave phenomena.** Lewis, D.K. Lawrence Livermore National Lab., CA (United States). 9 Sep 1992. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9205354–1: 5. Spring School on acousto-optics and applications, Gdansk/Jurata (Poland), 25-29 May 1992). Order Number DE93016425. Source: OSTI; NTIS; GPO Dep.

An acousto-optical measurement method is described which was used to conduct proof of principle experiments for a novel acoustic pulse system. The pulse theory, the Localized Wave pulse, is discussed and the system explained and described. The results of the experiments confirm the Localized Wave theory.

27729 (UCRL-JC–112286) **Sub-grid scale modeling for large eddy simulations in analysis of shock-turbulence interactions.** Buckingham, A.C. (Lawrence Livermore National Lab., CA (United States)); Grun, J. Lawrence Livermore National Lab., CA (United States). Dec 1992. 16p. Sponsored by USDOE, Washington, DC (United States); Department of Defense, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-930785–1: 8. international conference on numerical methods in laminar and trubulent flow, Swansea (United Kingdom), 18-23 Jul 1993). Order Number DE93013425. Source: OSTI; NTIS; GPO Dep.

We continue to study the influence of dynamic shock wave interactions on turbulence. The interactions may significantly increase turbulent energy and Reynolds stress. Strong support for tensor amplification is supplied by the sharp, transiently distorted strain field in the immediate neighborhood of the shock. Beyond this there develops a gradual decay to a new, more modestly amplified state relative to the pre-shocked level. Practical interest is centered on the significantly altered, albeit shock localized, post-shock turbulent kinetic energy, eddy transport, eddy component mixing and diffusion, wall shear, and heat transfer. In the shock interaction and post-shock region, compressible two dimensional large eddy simulations (LES) are applied. A compressibility modified Smagorinsky model is adapted to represent the non-resolved sub-grid scales. Favre mass-weighted average space and time discretized compressible Navier-Stokes equations are used to represent the explicitly resolved grid scale motions. Predicted amplification levels, modal energy partition, shock translational to turbulence kinetic energy transfer, and viscoelastic response of turbulence to shock interaction are examined in comparison with available experimental evidence. A two-band dynamic eddy viscosity model representing the unresolved subgrid scale field is a possible replacement for the Smagorinsky model. Improvement is sought for predictions in the near wall region, under the influence of stochastic subgrid scale backscatter, and in the neighborhood of the shock. Wall-bounded supersonic compression corner flow experiments and hypersonic cylindrical shock wave turbulence interaction experiments are used as trial cases for test and comparison of the two classes of subgrid scale models.

27730 (UCRL-JC–113606) **The first data from the MACHO experiment.** Bennett, D.P. (Lawrence Livermore National Lab., CA (United States)); Cook, K.H.; Akerlof, C.; Perlmutter, S.; Sutherland, W.; Alcock, C.; Allsman, R.; Axelrod, T.; Park, H.S.; Freeman, K.; Peterson, B.; Quinn, P. Lawrence Livermore National Lab., CA (United States). 17 Mar 1993. 7p. Sponsored by USDOE, Washington, DC (United States); California Univ., Berkeley, CA (United States). DOE Contract W-7405-ENG-48. (CONF-921266–2: Texas/PASCO '92 international conference, Berkeley, CA (United States), 13-18 Dec 1992). Order Number DE93014423. Source: OSTI; NTIS; GPO Dep.

MAssive Compact Halo Objects such as brown dwarfs, Jupiters, and black holes are prime candidates to comprise the dark halo of our galaxy. Paczynski noted that objects (dubbed MACHOS) with masses in the range $10^{-6}\ M\odot < M \lesssim 100M\odot$ can be detected via gravitational microlensing of stars in the Magellanic Clouds with the caveat that only about one in 10^6 stars will be lensed at any given time. Our group has recently begun a search for microlensing using a refurbished 1.27 meter telescope at the Mount Stromlo Observatory in Australia. Since the summer of 1992, we have been imaging up to 10^7 stars a night in the Large Magellanic Cloud using our large format two-color 3.4×10^7 pixel CCD camera. Here I report on our first results based on an analysis of $\sim 10^6$ of these stars. Although this is not enough data to make definitive statements about the nature of the dark matter, we are able to conclude that the rate of variable star background events is not larger than the expected MACHO signal.

6621 General Theory of Particles and Fields

Refer also to citation(s) 27673, 27687, 27717, 27763, 27772, 27934

27731 (DOE/ER/40560–4A) **Theoretical high energy physics research at the University of Chicago: Progress report, October 1, 1992–April 30, 1993.** Rosner, J.L.; Martinec, E.J.; Sachs, R.G. Chicago Univ., IL (United States). Apr 1993. 31p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-90ER40560. Order Number DE93016863. Source: OSTI; NTIS; INIS; GPO Dep.

Brief narrative descriptions of work performed are given on numerous topics including the following: CP violation, Cabibbo–Kobayashi–Maskawa matrix, and B physics; radiative corrections and electroweak observables; heavy quark symmetry; heavy meson

spectroscopy; composite models of quarks and leptons; supersymmetric quantum mechanics, inverse scattering, and the vertex operator; cosmological constraints on lepton-number violation in SO(10) models; black hole evaporation; the light cone in string theory; surfaces in the 3D Ising model; and conformal field theories.

27732 (DOE/ER/40699–2) **Theoretical high energy physics: [Annual report], May 1, 1992–April 30, 1993.** Lee, T.D. Columbia Univ., New York, NY (United States). [1993]. 25p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-92ER40699. Order Number DE93015884. Source: OSTI; NTIS; INIS; GPO Dep.

Brief reports are given on the work of several professors. The following areas are included: quantum chromodynamics calculations using numerical lattice gauge theory and a high-speed parallel computer; the "spin wave" description of bosonic particles moving on a lattice with same-site exclusion; a high-temperature expansion to 13th order for the O(4)-symmetric ϕ^4 model on a four-dimensional F_4 lattice; spin waves and lattice bosons; superconductivity of C_{60}; meson-meson interferometry in heavy-ion collisions; baryon number violation in the Standard Model in high-energy collisions; hard thermal loops in QCD; electromagnetic interactions of anyons; the relation between Bose-Einstein and BCS condensations; Euclidean wormholes with topology $S^1 \times S^2 \times R$; vacuum decay and symmetry breaking by radiative corrections; inflationary solutions to the cosmological horizon and flatness problems; and magnetically charged black holes.

27733 (IC–93/83) **Derivation of the Verlinde formula from Chern-Simons theory and the G/G model.** Blau, M.; Thompson, G. International Centre for Theoretical Physics, Trieste (Italy). May 1993. [47p.] Order Number DE93628620. Source: OSTI; NTIS (US Sales Only); INIS.

We give a derivation of the Verlinde formula for the G_k WZW model from Chern-Simons theory, without taking recourse to CFT, by calculating explicitly the partition function $Z_{\Sigma xS}{}^1$ of ΣxS^1 with an arbitrary number of labelled punctures. By a suitable gauge choice, $Z_{\Sigma xS}{}^1$ is reduced to the partition function of an Abelian topological field theory on Σ (a deformation of non-Abelian BF and Yang-Mills theory) whose evaluation is straightforward. This relates the Verlinde formula to the Ray-Singer torsion of ΣxS^1. We derive the G_k/G_k model from Chern-Simons theory, proving their equivalence and give an alternative derivation of the Verlinde formula by calculating the G_k/G_k path integral via a functional version of the Weyl integral formula. From this point of view the Verlinde formula arises from the corresponding Jacobian, the Weyl determinant. Also, a novel derivation of the shift $k \rightarrow k+h$ is given, based on the index of the twisted Dolbeault complex. (author). 28 refs.

27734 (IC–93/84) **Unbounded components in parameter space of rational maps.** Makienko, P.M. International Centre for Theoretical Physics, Trieste (Italy). May 1993. [21p.] Order Number DE93628621. Source: OSTI; NTIS (US Sales Only); INIS.

We apply the pinching construction to the study of boundaries of space of quasi-conformal deformations of rational maps. (author). 11 refs, 3 pictures.

27735 (IC–93/94) **A general solution of the BV-master equation and BRST field theories.** Dayi, O.F. International Centre for Theoretical Physics, Trieste (Italy). May 1993. [11p.] Order Number DE93628622. Source: OSTI; NTIS (US Sales Only); INIS.

For a class of first order gauge theories it was shown that the proper solution of the BV-master equation can be obtained straightforwardly. Here we present the general condition which the gauge generators should satisfy to conclude that this construction is relevant. The general procedure is illustrated by its application to the Chern-Simons theory in any odd-dimension. Moreover, it is shown that this formalism is also applicable to BRST field theories, when one replaces the role of the exterior derivative with the BRST charge of first quantization. (author). 17 refs.

27736 (IC–93/112) **1992 Trieste lectures on topological gauge theory and Yang-Mills theory.** Thompson, G. International Centre for Theoretical Physics, Trieste (Italy). May 1993. [74p.] Order Number DE93631804. Source: OSTI; NTIS (US Sales Only); INIS.

In these lecture notes we explain a connection between Yang-Mills theory on arbitrary Riemann surfaces and two types of topological field theory, the so called BF and cohomological theories. The quantum Yang-Mills theory is solved exactly using path integral techniques. Explicit expressions, in terms of group representation theory, are obtained for the partition function and various correlation functions. In a particular limit the Yang-Mills theory devolves to the topological models and the previously determined correlation functions give topological information about the moduli spaces of flat connections. In particular, the partition function yields the volume of the moduli space for which an explicit expression is derived. These notes are self contained, with a basic introduction to the various ideas underlying the topological field theories. This includes some relatively new work on handling problems that arise in the presence of reducible connections, which in turn, forms the bridge between the various models under consideration. These notes are identical to those made available to participants of the 1992 summer school in Trieste, except for one or two additions added circa January 1993. (author). 52 refs, 6 figs.

27737 (IC–93/116) **Finite-dimensional representations of the quantum superalgebra $U_q[gl(2/2)]$: 1. Typical representations at generic q.** Nguyen Anh Ky. International Centre for Theoretical Physics, Trieste (Italy). May 1993. [40p.] Order Number DE93631813. Source: OSTI; NTIS (US Sales Only); INIS.

In the present paper we construct all typical finite-dimensional representations of the quantum Lie superalgebra $U_q[gl(2/2)]$ at generic deformation parameter q. As in the non-deformed case the finite-dimensional $U_q[gl(2/2)]$-module W^q obtained is irreducible and can be decomposed into finite-dimensional irreducible $U_q[l(2)+gl(2)]$submodules $V_i{}^q$. (authohor). 32 refs.

27738 (IFVE-OTF–91-181) **Four-fermion interactions: The dynamic parity violation and the Chern-Simons term.** Klimenko, K.G. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov (Russian Federation). Inst. Fiziki Vysokikh Ehnergij. 1992. [16p.] (IHEP-OTF–91-181.). Order Number DE93629905. Source: OSTI; NTIS (US Sales Only); INIS.

The (2+1)-dimensional theory with a four-fermion interaction of a general type has been investigated. The conditions obtained specify the possibility for the dynamic generation of the Chern-Simons (CS) term. As has been shown. A spontaneous P-parity violation does not always result in the generation of CS terms; there is vacuum in which both the chiral invariance and P-parity are violated; models with fermion vector-vector couplings are a particular case of the given theory. 10 refs.

27739 (JINR-E–2-91-580) **About symmetry of the gravitational action.** Tentyukov, M.N. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Theoretical Physics. 1991. [6p.] Order Number DE93629955. Source: OSTI; NTIS (US Sales Only); INIS.

Submitted to Phys. Lett., A.

The Einstein equations are investigated by imbedding of the metric tensor to the affinely connected space. It is shown that if using of the Einstein equations, then, despite the action functional invariance being violated with respect to the diffeomorphism group by the background object, a new infinite-parameter invariance appears, i.e., the action invariance can be extended from the group of motions of the background object to any infinite-parameter group. 10 refs.

27740 (JINR-E–2-92-273) **Impulsive moving mirror model and the stability of linear homogeneous differential equations with impulse effect in a Banach space.** Kostadinov, S.I.; Petrov, G. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Theoretical Physics. 1992. [7p.] Order Number DE93629906. Source: OSTI; NTIS (US Sales Only); INIS.

From a special class of systems has been used the linear homogeneous differential equations with impulse effect in Minkowski space field theory with time dependent boundary conditions, i.e. those of moving mirrors. The field theoretical approach for studing the properties of the vacuum starts from an analysis of the behaviour of local field quantities in Minkowski space with uniformly moving mirrors. For the impulsive moving mirror model is the real process of interaction between the quantum field and the external

mirror a subject to disturbances in its evolution acting in time very short compared with the entire duration of the process. The stability of the process in the stability of the vacuum state energy. 7 refs.

27741 (JINR-E-2-92-287) **Phase structure of $(\phi^4)_3$ field theory at finite temperature.** Efimov, G.V. (Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Theoretical Physics); Nedel'ko, S.N. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Theoretical Physics. 1992. [19p.] Order Number DE93629907. Source: OSTI; NTIS (US Sales Only); INIS.

Submitted to Int. J. Mod. Phys. A.

Phase structure of ϕ^4 field theory in the space-time R^3 is investigated at arbitrary coupling constant and temperature. The critical values of the coupling constant and temperature, corresponding to the phase transitions in the system, are calculated by the canonical transformation method within formalism of thermo field dynamics. The Hamiltonians describing the system in each phase are obtained straightforwardly. Comparison with the two-dimensional case shows a crucial influence of higher order renormalization on the phase structure of the model. 13 refs.; 5 figs.

27742 (JINR-R-2-91-569) **On the Michelson-Morley experiment.** Strel'tsov, V.N. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of High Energy. 1991. [12p.] (In Russian). Order Number DE93629908. Source: OSTI; NTIS (US Sales Only); INIS.

The opinion about the important role of the Michelson-Morley experiment in the establishment of the principle of the constancy of the light velocity is expressed. It is noted that Fitzgerald - Lorentz contraction introduced for the explanation of its negative result contradicts to the Galilei transformations (and consequently, to ether theory). The theorem is proved that if a length of a moving rod is given by the instantaneous length, the propagation velocity of light along the rod is an inconstant quantity. It is stressed that the using of the radar length for the treatment of Michelson - Morley experiment leads to elongation formula for a longitudinal arm of the interferometer. 19 refs.

27743 (LIYaF-1770) **Generating functional for Donaldson invariants and operator algebra in topological D=4 Yang-Mills theory.** Johansen, A.A. AN SSSR, Leningrad (Russian Federation). Inst. Yadernoj Fiziki. 1992. [22p.] Order Number DE93629909. Source: OSTI; NTIS (US Sales Only); INIS.

It is shown, that under the certain constraints the generating functional for the Donaldson invariants in the D=4 topological Yang-Mills theory can be interpreted as a partition function for the renormalizable theory. 20 refs.

27744 (RAL-93-002) **Spontaneous baryogenesis in supersymmetric models.** Abel, S.A. (Rutherford Appleton Lab., Chilton (United Kingdom)); Cottingham, W.N.; Whittingham, I.B. Rutherford Appleton Lab., Chilton (United Kingdom). Jan 1993. [15p.] Order Number DE93629956. Source: OSTI; NTIS (US Sales Only); INIS.

In this paper we extent the results of previous work on spontaneous baryogenesis to general models involving charge-parity (CP) violation in the Higgs sector. We show how to deal with Chern-Simons terms appearing in the effective potential arising from phase changes in the vacuum expectation values of the Higgs fields. In particular, this enables us to apply this mechanism to general supersymmetric models including the minimal supersymmetric standard model, and the extended model with a gauge singlet. A comparison is made between this approach, and that in which one solves the equations of motion for Higgs winding modes. As anticipated in earlier work, the effect of the latter approach is found to be small. (Author).

6622 Specific Theories and Interaction Models; Particle Systematics

Refer also to citation(s) 27732, 27767, 27769, 27775, 27828, 27834

27745 (BNL-48922) **PHENIX Conceptual Design Report: An experiment to be performed at the Brookhaven National Laboratory Relativistic Heavy Ion Collider.** Brookhaven National Lab., Upton, NY (United States). 29 Jan 1993. 480p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. Order Number DE93015759. Source: OSTI; NTIS; INIS; GPO Dep.

The PHENIX Conceptual Design Report (CDR) describes the detector design of the PHENIX experiment for Day-1 operation at the Relativistic Heavy Ion Collider (RHIC). The CDR presents the physics capabilities, technical details, cost estimate, construction schedule, funding profile, management structure, and possible upgrade paths of the PHENIX experiment. The primary goals of the PHENIX experiment are to detect the quark-gluon plasma (QGP) and to measure its properties. Many of the potential signatures for the QGP are measured as a function of a well-defined common variable to see if any or all of these signatures show a simultaneous anomaly due to the formation of the QGP. In addition, basic quantum chromodynamics phenomena, collision dynamics, and thermodynamic features of the initial states of the collision are studied. To achieve these goals, the PHENIX experiment measures lepton pairs (dielectrons and dimuons) to study various properties of vector mesons, such as the mass, the width, and the degree of yield suppression due to the formation of the QGP. The effect of thermal radiation on the continuum is studied in different regions of rapidity and mass. The $e\mu$ coincidence is measured to study charm production, and aids in understanding the shape of the continuum dilepton spectrum. Photons are measured to study direct emission of single photons and to study π^0 and η production. Charged hadrons are identified to study the spectrum shape, production of antinuclei, the ϕ meson (via K^+K^- decay), jets, and two-boson correlations. The measurements are made down to small cross sections to allow the study of high p_T spectra, and J/ψ and Υ production. The PHENIX collaboration consists of over 300 scientists, engineers, and graduate students from 43 institutions in 10 countries. This large international collaboration is supported by US resources and significant foreign resources.

27746 (DOE/ER/40224-232) **Fractal interpretation of intermittency.** Hwa, R.C. Oregon Univ., Eugene, OR (United States). Dec 1991. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG06-85ER40224 ;FG06-91ER40637. (OITS-480;CONF-9109221-7: 21. international symposium on multiparticle dynamics, Wuhan (China), 23-27 Sep 1991). Order Number DE93010349. Source: OSTI; NTIS; INIS; GPO Dep.

Implication of intermittency in high-energy collisions is first discussed. Then follows a description of the fractal interpretation of intermittency. A basic quantity with asymptotic fractal behavior is introduced. It is then shown how the factorial moments and the G moments can be expressed in terms of it. The relationship between the intermittency indices and the fractal indices is made explicit.

27747 (DOE/ER/40388-102) **Research in theoretical nuclear physics: Progress report.** State Univ. of New York, Stony Brook, NY (United States). Dept. of Physics. Jun 1993. 131p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-88ER40388. Order Number DE93015096. Source: OSTI; NTIS; INIS; GPO Dep.

The introductory section describes the goals, main thrusts, and interrelationships between the various activities in the program and principal achievements of the Stony Brook Nuclear Theory Group during 1992-93. Details and specific accomplishments are related in abstract form. Current research is taking place in the following areas: strong interaction physics (the physics of hadrons, QCD and the nucleus, QCD at finite temperature and high density), relativistic heavy-ion physics, nuclear structure and nuclear many-body theory, and nuclear astrophysics.

27748 (DOE/ER/40560-4C) **Particle physics and cosmology, Task C: Progress report, January 1992-April 1993.** Turner, M.S. Chicago Univ., IL (United States). May 1993. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-90ER40560. Order Number DE93016865. Source: OSTI; NTIS; INIS; GPO Dep.

The research has spanned many topics at the boundary of particle physics and cosmology. The major focus has been in the general areas of inflationary cosmology, cosmological phase transitions, astrophysical constraints to particle physics theories, and dark matter/structure formation as it relates to particle physics. Some attention is given to axion physics. Narrative summaries of

the research of the individual group members are given, followed by a list of publications.

27749 (DOE/FTR–93013559) **Travel to Aachen, Germany, to attend the conference on recent developments and applications of the theory of quantum chromodynamics entitled "QCD – 20 years later": Foreign trip report, June 5–18, 1992.** Bardeen, W.A. Fermi National Accelerator Lab., Batavia, IL (United States). 12 Jul 1992. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. Order Number DE93013559. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The conference covered all aspects of QCD, but focused on the present status and recent developments and applications of the theory. Plenary sessions were held on the following topics: e^+e^- annihilation, deep inelastic scattering, hadron–hadron collisions, QCD at large distances, high-temperature QCD, and weak interactions. Parallel sessions included those dealing with heavy quarks, lattice QCD, lepton-nucleon physics, and nuclear physics.

27750 (GANIL-P–92-16) **Multiscaling in the hadronization in high energy collisions.** Bozek, P. (Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France)); Ploszajczak, M. Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France). [1992]. [20p.] Order Number DE93631816. Source: OSTI; NTIS (US Sales Only); INIS.

The multiscaling in the fluctuations of multiparticle distributions at small scales is studied. Similarly to the multiscaling effect, recently found in multifractal models, the dependence of the strength of the fluctuations on the low density cut-off in the cascade is analyzed. The effect changes the scaling behaviour and leads to stronger dependence of the scaled factorial moments on the resolution than the power law. This could be an explanation of the behaviour observed recently in the experimental 3-dimensional data on the scaled factorial moments. The multiscaling analysis allows to restore the universality in the processes with different cut-offs and could be used in the analysis of the experimental data. (author) 17 refs.; 4 figs.

27751 (GANIL-P–92-19) **The even-odd anomalous tunneling effect.** Kaminski, P. (Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France)); Ploszajczak, M.; Drozdz, S.; Caurier, E. Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France). [1992]. [14p.] Order Number DE93631836. Source: OSTI; NTIS (US Sales Only); INIS.

The analysis of the interacting fermion models with SU(2) symmetry indicates the different behaviour of the splittings of opposite parity lowest energy eigenstates for even and odd number of fermions. The imaginary time-dependent mean field approach reproduces the exact results only for the even number of particles. For the odd particle numbers, an introduction of the universal logarithmic term to the action integral is needed. The even-odd effect appears in a wide class of models with SU(2) symmetry and is connected with the presence of p^4-terms in the classical large N limit. (author) 13 refs.; 3 figs.

27752 (GANIL-P–92-21) **Radiative energy loss in the quark-gluon plasma.** Bozek, P. (Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France)). Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France). 7 Oct 1992. [11p.] Order Number DE93631831. Source: OSTI; NTIS (US Sales Only); INIS.

The gluon radiation from a decelerated quark in the quark-gluon plasma is calculated. The formalism treats the initial quark state classically interacting with the quantum electromagnetic field. The energy radiated in connection to the sudden appearance of the color charge is about 2 GeV. However, it is found that the energy radiation induced by the collisions with the plasma partons is small. This estimate favours the jet unquenching as a signal of the deconfined phase. (R.P.) 10 refs.; 2 figs.

27753 (IC–93/63) **Topologically stable electroweak flux tubes.** Dvali, G.; Senjanovic, G. International Centre for Theoretical Physics, Trieste (Italy). Apr 1993. [10p.] Order Number DE93628626. Source: OSTI; NTIS (US Sales Only); INIS.

We show that for a large range of parameters in a $SU(2)_L xU(1)$ electroweak theory with two Higgs doublets there may exist classically stable flux tubes of Z boson magnetic field. In a limit of an extra global U-tilde(1) symmetry, these flux-tubes become topologically stable. These results are automatically valid even if U-tilde(1) is gauged. (author). 10 refs.

27754 (IC–93/81) **On the twisted N=2 superconformal structure in 2d gravity coupled to matter.** Panda, S. (Institute for Theoretical Physics, Groningen (Netherlands)); Roy, S. International Centre for Theoretical Physics, Trieste (Italy). May 1993. [13p.] (UG–3/93.). Order Number DE93628627. Source: OSTI; NTIS (US Sales Only); INIS.

It is shown that the two dimensional gravity, described either in the conformal gauge (Liouville theory) or in the light cone gauge, when coupled to matter processes an infinite number of twisted N=2 superconformal symmetries. The central charges of the N=2 algebra for the two gauge choices are in general different. Further, it is argued that the physical states in the light cone gauge theory can be obtained from the Liouville theory by a field redefinition. (author). 18 refs.

27755 (IC–93/98) **2D supergravity and its connection to integrable models.** Arnaudov, L.N. (Sofia Univ., Sofia (Bulgaria). Dept. of Theoretical Physics); Prodanov, E.M.; Rashkov, R.C. International Centre for Theoretical Physics, Trieste (Italy). May 1993. [12p.] Grant F-214/2096. Order Number DE93631817. Source: OSTI; NTIS (US Sales Only); INIS.

In the recent work two different approaches for obtaining the covariant W_2-action of 2-d quantum supergravity are considered. The first one is based on Hamiltonian reduction of flat Osp(2/1) connection in holomorphic polarization. Adding extra degrees of freedom with the help of gauging procedure the W_2-action and the superconformal identities are obtained. It is shown that the super Virasoro transformations preserve the form of the Lax connection and therefore are symmetries of the sKdV equations. In the second approach starting with Chern-Simons theory and using noncanonical polarization the zero-curvature condition entails the same results. (author). 7 refs.

27756 (IC–93/105) **Selffield quantum electrodynamics without infinities. A new calculation of vacuum polarization.** Acikgoz, I. (International Centre for Theoretical Physics, Trieste (Italy)); Barut, A.O.; Unal, N.; Kraus, J. International Centre for Theoretical Physics, Trieste (Italy). May 1993. [8p.] Order Number DE93631822. Source: OSTI; NTIS (US Sales Only); INIS.

We have reevaluated analytically the vacuum polarization in Coulomb field using relativistic Coulomb wave functions by a new method. The result is finite giving the standard result in the lowest order of iteration. The formalism of selffield quantumelectrodynamics used here needs neither field quantization, nor renormalization. There are no infrared or ultraviolet divergences. (author). 18 refs.

27757 (LBL–33976) **Radiative corrections in the strongly interacting limit of the standard electroweak model.** Gaillard, M.K. Lawrence Berkeley Lab., CA (United States). 19 Apr 1993. 16p. Sponsored by USDOE, Washington, DC (United States); National Science Foundation, Washington, DC (United States). DOE Contract AC03-76SF00098. Grant PHY-90-21139;Grant PHY-89-04035. (UCB-PTH–93/14;NSF-ITP–93-42;CONF-930293–3: International symposium on 30 years of neutral currents, Los Angeles, CA (United States), 3-5 Feb 1993). Order Number DE93013906. Source: OSTI; NTIS; INIS; GPO Dep.

Radiative corrections to the parameters of the standard electroweak model are considered in case that there is no light Higgs particle.

27758 (NIKHEF-H–92-17) **The three-loop QCD β-function and anomalous dimensions.** Larin, S.A. (Nationaal Inst. voor Kernfysica en Hoge-Energiefysica (NIKHEF), Amsterdam (Netherlands). Sectie H); Vermaseren, J.A.M. Nationaal Inst. voor Kernfysica en Hoge-Energiefysica (NIKHEF), Amsterdam (Netherlands). Sectie H. 1992. [5p.] Order Number DE93629973. Source: OSTI; NTIS; INIS.

The analytic calculations of the three-loop QCD β-function and anomalous dimensions within the minimal subtraction scheme in an

arbitrary covariant gauge is presented. The result for the β-function coincides with the previous calculation. (author). 13 refs.

27759 (NIKHEF-H-92-18) **The renormalization of the axial anomaly in dimensional-regularization.** Larin, S.A. (Nationaal Inst. voor Kernfysica en Hoge-Energiefysica (NIKHEF), Amsterdam (Netherlands). Sectie H). Nationaal Inst. voor Kernfysica en Hoge-Energiefysica (NIKHEF), Amsterdam (Netherlands). Sectie H. 1992. [11p.] Order Number DE93629974. Source: OSTI; NTIS; INIS.

The prescription of the γ_5-matrix within dimensional regularization in multiloop calculations is elaborated. The three-loop anomalous dimension of the singlet axial current is calculated. (author). 24 refs., 1 fig.

27760 (RAL-92-073) **On the validity of perturbative evolution of structure functions from low Q^2.** Forshaw, J.R. Rutherford Appleton Lab., Chilton (United Kingdom). Nov 1992. [18p.] Order Number DE93629975. Source: OSTI; NTIS (US Sales Only); INIS.

The validity of using quantum chromodynamics (QCD) perturbation theory to generate dynamically the parton distribution functions of hadrons, starting from a valence-like input at low Q^2, is discussed. In particular, we consider the prescription of previous authors who evolve from Q^2 O, and those who start evolution from $Q^2 \simeq (2 \Lambda\ QCD)^2$. (Author).

27761 (RAL-93-003) **Implications for minimal supersymmetry from grand unification and the neutralino relic abundance.** Roberts, R.G. (Rutherford Appleton Lab., Chilton (United Kingdom)); Roszkowski, L. Rutherford Appleton Lab., Chilton (United Kingdom). Jan 1993. [15p.] Order Number DE93631818. Source: OSTI; NTIS (US Sales Only); INIS.

We examine various predictions of the minimal supersymmetric standard model coupled to minimal supergravity. The model is characterised by a small set of parameters at the unification scale. The supersymmetric particle spectrum at low energy and the spontaneous breaking of the standard model itself are then generated radiatively. The previously considered predictions of the model now include the neutralino relic density which in turn provides bounds on the scale parameters. We find a remarkable consistency among several different constraints which imply all supersymmetric particle masses preferably within the reach of future supercolliders (Large Hadron Collider (LHC) and Superconducting Super Collider (SSC)). The requirement that the neutralino be the dominant component of (dark) matter in the flat Universe provides a lower bound on the spectrum of supersymmetric particles beyond the reach of the European Large Electron -Positron storage rings (LEP), and most likely also the Tevatron and LEP 200. (author).

27762 (UWThPh-1992-60) **QCD condensate values from analytical structure of pion's form factor via sum rules methods.** Meshcheryakov, D.V. (High Energy Physics and Quantum Theory Division, Physics Dept., Moscow State Univ., Leninskie Gory, 119899 Moscow (Russian Federation)). Vienna Univ. (Austria). Inst. fuer Theoretische Physik. 17 Nov 1992. [10p.] Order Number DE93628912. Source: OSTI; NTIS (US Sales Only); INIS.

A simple pion's form factor representation with physically reasonable analytical structure is applied to QCD sum rules methods. QCD condensate values are obtained through finite-energy sum rules (FESR) and Shifman-Vainstein-Zakharov sum rules (SVZ). The increase of gluon and four quark condensate values previously predicted is confirmed. (author).

27763 (WIS-PH-92-103) **Construction of realistic superstring standard-like models.** Faraggi, A.E. Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Physics. Dec 1992. [9p.] (CONF-921266-: Texas/PASCO '92 international conference, Berkeley, CA (United States), 13-18 Dec 1992). Order Number DE93629967. Source: OSTI; NTIS (US Sales Only); INIS.

I discuss the construction of realistic superstring standard-like models in the four dimensional free fermionic formulation. I discuss proton lifetime constraints on superstring models. I discuss the massless spectrum of the superstring standard-like models, the texture of fermion mass matrices in these models are argue that the realistic features of these models are due to the underlying $Z_2 * Z_2$ orbifold compactification. (author).

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Refer also to citation(s) 27725, 27746, 27802, 27824, 27857

27764 (ANL-HEP-CP-93-32) **Status of the Soudan 2 detector experiment.** Ambats, I. (Argonne National Lab., IL (United States)); Ayres, D.S.; Balka, L.; Barrett, W.L.; Dawson, J.; Fields, T.; Goodman, M.C.; Hill, N.; Hoftiezer, J.H.; Jankowski, D.J.; Lopez, F.; May, E.N.; Price, L.E.; Schlereth, J.; Thron, J.L.; Trost, H.J.; UrArgonne National Lab., IL (United States). [1993]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-930779-16: International cosmic-ray conference, Calgary (Canada), 19-20 Jul 1993). Order Number DE93015549. Source: OSTI; NTIS; GPO Dep.

The status of the Soudan 2 experiment is discussed. The detector parameters, running schedule, and physics program are presented. Limits on proton decay, the flux of highly ionizing magnetic monopoles and neutrinos from active galactic nuclei are given.

27765 (ANL-HEP-CP-93-33) **Are there atmospheric neutrino oscillations?.** Goodman, M.C. Argonne National Lab., IL (United States). [1993]. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-930779-17: International cosmic-ray conference, Calgary (Canada), 19-20 Jul 1993). Order Number DE93015550. Source: OSTI; NTIS; GPO Dep.

The neutrino oscillation explanation ($\nu_\mu \rightarrow \nu_\tau$) of the atmospheric neutrino deficit is often discussed but is far from widely accepted. This paper discusses several experimental observations, and how a consistent picture pointing towards neutrino oscillations might develop.

27766 (BNL-48717) **The E2 N→Δ transition from polarized Compton scattering.** Sandorfi, A.M. (Brookhaven National Lab., Upton, NY (United States)); Caracappa, A.; Kistner, O.C.; Thorn, C.E.; Miceli, L.; Giordano, G.; Matone, G.; Schaerf, C.; Blanpied, G.; Djalali, C.; Preedom, B.M. Brookhaven National Lab., Upton, NY (United States). [1993]. 2p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-930637-1: 13. international conference on particles and nuclei, Perugia (Italy), 27 Jun - 3 jul 1993). Order Number DE93012522. Source: OSTI; NTIS; INIS; GPO Dep.

Short communication. E2-TRANSITIONS/compton effect; NUCLEONS/e2-transitions; DELTA BARYONS/e2-transitions; E2-TRANSITIONS; SCATTERING; NUCLEONS; PHOTON-PROTON INTERACTIONS

27767 (BNL-48832) **Polarization and color transparency.** Bunce, G. EVA Collaboration. Brookhaven National Lab., Upton, NY (United States). [1993]. 4p. Sponsored by USDOE, Washington, DC (United States); National Science Foundation, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-930389-12: Future directions in particle and nuclear physics at multi-GeV hadron beam facilities, Upton, NY (United States), 4-6 Mar 1993). Order Number DE93014319. Source: OSTI; NTIS; INIS; GPO Dep.

Color transparency offers an interesting experimental test of our understanding of hadronic polarization effects which have been seen at high energy. Large polarization effects have been seen for exclusive high momentum transfer reactions which are incompatible with lowest order pQCD. It is proposed to filter these reactions by scattering inside a nucleus. We expect that only color transparent hadrons would survive, and that these should be products of "hard" scattering. If the polarization arrises from a non-perturbative "soft" effect, the nucleus should filter these reaction products away. We should see no polarization remaining after the reaction is filtered by a large nucleus.

27768 (BNL-48871) **Early baryon and meson spectroscopy culminating in the discovery of the Omega minus SU(3) and quarks.** Samios, N.P. Brookhaven National Lab., Upton, NY (United States). [1993]. 24p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-9306168-1: 3. international symposium on the history of particle physics: the rise of the standard model, Stanford, CA (United States), 24-27 Jun 1993). Order Number DE93014321. Source: OSTI; NTIS; INIS; GPO Dep.

This report discusses the early experimental and theoretical research that resulted in the discovery of the omega minus particles, quarks, and other subatomic particles.

27769 (BNL–48876) **Theoretical status of J/ψ suppression.** Gavin, S. Brookhaven National Lab., Upton, NY (United States). Mar 1993. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-9301109–2: 2. international conference on physics and astrophysics of quark-gluon plasma, Calcutta (India), 19-23 Jan 1993). Order Number DE93014290. Source: OSTI; NTIS; INIS; GPO Dep.

High energy heavy ion collisions are expected to produce hadron densities far beyond the density in nuclei, $\rho_0 = 0.16$ fm^{-3}. Remarkably, no single measurement from the AGS and SPS light ion programs with projectiles A $\leq$ 32 stands out as unambiguous evidence of these extreme densities. To separate the high density signals from the background effects that result, e.g. from scattering with primary nucleons, careful systematic studies of hadron-nucleus, hA, and nucleus-nucleus, AB, data are needed. In this talk the author surveys the ongoing systematic study of the most notorious case in point – J/ψ suppression. In principle, measurements of J/ψ suppression provide a probe of the densities obtained in AB collisions that is also sensitive to quark gluon plasma production. The latest results from SPS experiment NA38 reported by A. Romana in these proceedings show that the ratio of cross sections in the dimuon channel $B_{\mu\mu}\sigma_\psi/\sigma_{cont}$ is reduced by a factor 0.50 ± 0.05 in central S+U compared to minimum bias pU collisions at 200 AGeV. This is precisely the sort of suppression that one expects if high densities are obtained. On the other hand, a target-mass dependence suggestive of this suppression is found in hA collisions where high densities are not expected. At 200 GeV, NA38 finds that $B_{\mu\mu}\sigma_\psi/\sigma_{cont}$ falls to 0.84 ± 0.08 in pU compared to pCu. The hA suppression in this kinematic regime is likely due to a combination of nuclear effects: nucleon absorption and shadowing.

27770 (DOE/ER/10713–T4) **[Study of electroweak interactions]: Final report [February 1, 1992–January 31, 1993].** Abashian, A. Virginia Polytechnic Inst. and State Univ., Blacksburg, VA (United States). Dept. of Physics. [1993]. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AS05-80ER10713. Order Number DE93015067. Source: OSTI; NTIS; INIS; GPO Dep.

This report is the final technical report for research conducted during the period February 1, 1992 to January 31, 1993. It covers three primary activities: The AMY experiment on the study of final states produced in e^+e^- collisions at $\sqrt{s} \simeq$ 60GeV, the MEGA/RHO experiment on the study of decay modes of the muon, and the R&D program on the development of resistive plate chambers for use at B factory electron colliders and possible SSC experiments.

27771 (DOE/ER/40160–9) **High energy hadron-hadron collisions: Annual progress report.** Chou, T.T. Georgia Univ., Athens, GA (United States). Dept. of Physics and Astronomy. [1992]. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG09-84ER40160. Order Number DE93015584. Source: OSTI; NTIS; INIS; GPO Dep.

Results of a study on high energy collisions with the geometrical model are summarized in three parts: (1) the elastic hadron-hadron collision, (2) the inelastic hadron-hadron collision, and (3) e^+e^- annihilation. For elastic scattering, a modified form for the hadronic matter form factor of the proton was proposed which is still dipole in form but contains an energy–dependent range parameter. This new expression of the opacity function fits the elastic $\bar{p}p$ scattering very well from the ISR to S$\bar{p}$pS energies. Extrapolation of this theory also yielded results $\bar{p}p$ in good agreement with the $\bar{p}p$ differential cross section measured at the Tevatron. For inelastic hadron-hadron collisions, we have made a systematic investigation of the single-particle momentum spectra in the entire S$\bar{p}$pS energy region. Results are useful for the extrapolation of angular distribution to the higher SSC energies. In e^+e^- annihilation, a detailed analysis of all available experimental multiplicity data from PETRA to LEP energies has been performed. The cluster size of emitted hadrons increases gradually with energy. Aside from high-energy collisions, the giant fullerene molecules were studied and precise algebraic eigenvalue expressions of the Hueckel problem for carbon-240 were obtained.

27772 (DOE/ER/40560–4B) **Experimental study of weak interactions by precision measurement by rare kaon decay: Progress report, October 1, 1992–April 30, 1993.** Winston, R. Chicago Univ., IL (United States). Apr 1993. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-90ER40560. Order Number DE93016864. Source: OSTI; NTIS; INIS; GPO Dep.

Brief status reports are given on searches for direct CP and CPT violation, and a search for further evidence of CP violation through rare kaon decays such as $K_L \rightarrow \pi^0 e^+ e^-$.

27773 (DOE/ER/40765–T1) **Standard model tests in muon decay with the MEGA detector: Progress report, July 16, 1992–May 31, 1993.** Gagliardi, C.A.; Tribble, R.E. Texas A and M Univ., College Station, TX (United States). [1993]. 26p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG03-93ER40765. Order Number DE93017556. Source: OSTI; NTIS; INIS; GPO Dep.

This report discusses the detector system used to detect the semileptonic decay of the muon. Some of the results of this experiment are given.

27774 (DOE/FTR–93012251) **[Travel to La Plata, Argentina, to attend as external examiner the Ph.D. examination of now Dr. Antonio Bouzas and to hold discussions on the organization of the next ELAF 1993]: Foreign trip report, September 5–19, 1992.** Hojvat, C. Fermi National Accelerator Lab., Batavia, IL (United States). 4 Oct 1992. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. Order Number DE93012251. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The Elementary Particles Phenomenology Group of the Physics Department of the Universidad de La Plata, Argentina, hosted the visit between September 9 and September 12. The purpose of the trip was to attend as external examiner the Ph.D. examination of now Dr. Antonio Bouzas and to hold discussions on the organization of the next ELAF 1993 (1993 Latin American School of Physics). The examination took place on September 11. As the thesis was based on the E735 Fermilab experiment data, an update of its analysis was presented. The visitor is the organizer of the Experimental Physics with Accelerators session of the ELAF 1993.

27775 (FNAL/C–92/345-E) **Quark and gluon jets at CDF.** Wainer, N. CDF Collaboration. Fermi National Accelerator Lab., Batavia, IL (United States). Nov 1992. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. (CONF-921122–66: Meeting of the Division of Particles and Fields of the American Physical Society, Batavia, IL (United States), 10-14 Nov 1992). Order Number DE93014919. Source: OSTI; NTIS; INIS; GPO Dep.

Jet shapes at $\sqrt{s}$ = 1.8 TeV have been measured by CDF at the Fermilab Tevatron Collider. The jet shape is mainly formed by parton emission before hadronization. The jet shapes may also be used to differ between quark and gluon jets. Two approaches are tried. Jet shape variables are input to a feed forward neural network trained on QCD Monte Carlos. We observe a variation of the quark content of jets as a function of jet transverse energy. The second approach consists of constructing a likelihood function, based on Monte Carlo predictions, with the Mellin moments of the momentum of charged tracks in jets. Differences are found between gluon-like jets in 2-jet events and quark-like jets in photon-jet events.

27776 (FNAL/C–93/044-E) **Direct photon production from D0.** Snow, G.R. (Michigan Univ., Ann Arbor, MI (United States). Dept. of Physics). D0 Collaboration. Fermi National Accelerator Lab., Batavia, IL (United States). Nov 1992. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. (CONF-921122–62: Meeting of the Division of Particles and Fields of the American Physical Society, Batavia, IL (United States), 10-14 Nov 1992). Order Number DE93014718. Source: OSTI; NTIS; INIS; GPO Dep.

A preliminary differential cross section $d^2\sigma/d_{pT}d_\eta$ for the inclusive production of direct photons, $p\bar{p} \rightarrow \gamma + X$, at $\sqrt{s}$ = 1.8 TeV is presented. Photon candidate events included in the cross section are in the transverse momentum range 14 < pT < 90 GeV/c and the pseudorapidity range $-0.9 < \eta < 0.9$. The estimate of the

background in the photon candidate sample due to multi-photon sources is discussed. The data are compared with recent next-to-leading-order predictions.

27777 (FNAL/C–93/045/E) **A search for scalar leptoquarks in D0.** Merritt, K.W. D0 Collaboration. Fermi National Accelerator Lab., Batavia, IL (United States). Nov 1992. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. (CONF-921122–52: Meeting of the Division of Particles and Fields of the American Physical Society, Batavia, IL (United States), 10-14 Nov 1992). Order Number DE93012780. Source: OSTI; NTIS; INIS; GPO Dep.

A search has been made using the data from the first run of the D0 detector at the Fermilab Tevatron for pair production of scalar leptoquarks, each decaying into electron plus quark (visible in the detector as electron plus jet). From a data sample representing 841 nb^{-1}, a limit of 74 GeV at 95% confidence level can be set on the mass of the first generation scalar leptoquark, for a particular calculation of the production cross section and a 100% branching fraction into electron plus quark.

27778 (FNAL/C–93/048/E) **Inclusive single muons at D0.** Bazizi, K.A. (California Univ., Riverside, CA (United States)). D0 Collaboration. Fermi National Accelerator Lab., Batavia, IL (United States). Nov 1992. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. (CONF-921122–53: Meeting of the Division of Particles and Fields of the American Physical Society, Batavia, IL (United States), 10-14 Nov 1992). Order Number DE93012779. Source: OSTI; NTIS; INIS; GPO Dep.

We report preliminary results on b-quark production in $p\bar{p}$ collisions at $\sqrt{s}$ = 1.8 TeV from the current Run Ia of the Tevatron collider. Using an inclusive muon data sample which corresponds to an integrated luminosity of 50–70 nb^{-1} and by further requiring the muon to be accompanied by a jet we obtain an almost background free sample of muons consistent with $b\bar{b} \rightarrow \mu X$ decay. A preliminary $p_T{}^{\mu}$ spectrum and some characteristics of this decay, compared to the Monte Carlo expectations, are presented.

27779 (FNAL/C–93/050-E) **Two jet energy and rapidity distributions.** Blazey, G.C. For the DO Collaboration. Fermi National Accelerator Lab., Batavia, IL (United States). Nov 1992. 5p. Sponsored by USDOE, Washington, DC (United States); National Science Foundation, Washington, DC (United States). DOE Contract AC02-76CH03000. (CONF-921122–60: Meeting of the Division of Particles and Fields of the American Physical Society, Batavia, IL (United States), 10-14 Nov 1992). Order Number DE93014026. Source: OSTI; NTIS; INIS; GPO Dep.

The D0 detector has been recording data at the Tevatron $\bar{p}p$ Collider since May 1992. Because the D0 calorimeter is hermetic and has large acceptance it is well suited for semi-exclusive final state jet studies. We present a primary measurement of the distribution $d^3N/dE_{T1}/d\eta_1/d\eta_2$ at $\sqrt{s}$ TeV over a large range of η. The sensitivity of this cross-section to parton momentum distributions and the ability of D0 to discriminate between possible parton distributions is discussed.

27780 (FNAL/C–93/055-E) **W and Z decays to electrons in D0.** Graf, N.A. (Brookhaven National Lab., Upton, NY (United States)). D0 Collaboration. Fermi National Accelerator Lab., Batavia, IL (United States). Nov 1992. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. (CONF-921122–61: Meeting of the Division of Particles and Fields of the American Physical Society, Batavia, IL (United States), 10-14 Nov 1992). Order Number DE93014719. Source: OSTI; NTIS; INIS; GPO Dep.

The D0 detector has been accumulating data at the Fermilab Tevatron at $\sqrt{s}$ = 1.8TeV for several months. In this paper we present the results of a preliminary analysis of W and Z vector boson decays into electrons based on 1.1pb^{-1} of data collected from Aug. 26. 1992 through Nov. 2, 1992. The event characteristics, as well as the number of events detected, are in good agreement with expectations.

27781 (FNAL/C–93/146-E) **Direct photon results from CDF.** Flaugher, B. CDF Collaboration. Fermi National Accelerator Lab., Batavia, IL (United States). Jun 1993. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. (CONF-930363–3: 28. conference on quantum chromodynamics and high energy hadronic interactions, Les Arcs (France), 20-27 Mar 1993). Order Number DE93016349. Source: OSTI; NTIS; INIS; GPO Dep.

Results using photons measured with the CDF detector during the 1992–93 run of the Fermilab Tevatron are presented. Photon detection and background suppression are described. Measurement of the inclusive photon cross section as well as photon-jet cross sections are discussed and compared to next-to-leading order QCD predictions. The search for excited quarks using the photon-jet mass distribution is described and a limit is derived.

27782 (GANIL-T–92-02) **Multiparticle correlations and intermittency in high energy collisions.** Bozek, P. (Institute of Nuclear Physics, Cracow (Poland)). Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France). 1992. [87p.] Order Number DE93631838. Source: OSTI; NTIS (US Sales Only); INIS.

The analysis of the intermittency signal observed in high energy experiments is presented using multiparticle distributions and correlation functions. The effect of the dimensional projection of the multiparticle distributions on one or two-dimensional subspace is discussed. The structure of the multiparticle cumulants is analyzed for the DELPHI e^+e^- annihilation data. The model of spatiotemporal intermittency is discussed in details and is shown to reproduce qualitatively the dependence of the intermittency strength on the target and projectile nuclei. A 1-dimensional (1D) cellular-automaton and a 1D forest-fire model is studied. On the example of the noncritical 1D Ising model the difficulties of the scaled factorial moment (SFM) method in extracting genuine scaling behaviour is illustrated. All these studies could serve as tools to test the sensibility of the SFM method as used in the analysis of the high energy production. (K.A.) 122 refs.; 38 figs.; 3 tabs.

27783 (IC–93/109) **Non-standard model couplings in WWV vertex.** Harun ar Rashid, A.M.; Saiful Islam, K. International Centre for Theoretical Physics, Trieste (Italy). May 1993. [28p.] Order Number DE93631837. Source: OSTI; NTIS (US Sales Only); INIS.

Using the non-standard model vertex for WWV coupling, the helicity amplitudes, differential cross-sections and total cross-sections for the process $e^+e^- \rightarrow W^+W^-$ as functions of k_V and λ_V have been calculated, and compared with SM predictions. A similar calculation has also been done for the process $e\gamma \rightarrow WV_{\bullet}$. (author). 15 refs, 12 figs.

27784 (IC–93/111) **Asymmetry in high energy hadron-hadron collisions.** Hussein, M.T. (International Centre for Theoretical Physics, Trieste (Italy)); Hassan, N.M.; Rabea, A. International Centre for Theoretical Physics, Trieste (Italy). May 1993. [14p.] Order Number DE93631839. Source: OSTI; NTIS (US Sales Only); INIS.

The asymmetry in hadron-hadron interactions is studied via the frame of a proposed multiperipheral model, where inclusive particle distributions are reproduced by the Monte Carlo technique. The dependence of the asymmetry upon the incident energy and the interacting particles is explained in view of the hadron-hadron quark structure. Calculations are compared with data of πp and pp at 50, 100 and 200 GeV incident hadron energy. (author). 8 refs, 5 figs, 2 tabs.

27785 (JINR-E–2-91-553) **B→C flavour changing decays of baryons containing a single heavy quark.** Efimov, G.V. (Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Theoretical Physics); Ivanov, M.A.; Kulimanova, N.B.; Lyubovitskij, V.E. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Theoretical Physics. 1991. [23p.] Order Number DE93630001. Source: OSTI; NTIS (US Sales Only); INIS.

Submitted to Z. Phys., C.

A detailed description of semileptonic decays of baryons $\Lambda_b{}^0 \rightarrow \Lambda_c{}^+$ and $\Sigma_b{}^+ \rightarrow \Sigma_c{}^{++}$ in the framework of the quark confinement model, relativistic quark model based on definite assumptions about hadronization and confinement of light quarks is presented. Weak form factors, decay rates and differential distributions of semileptonic decays $\Lambda_b{}^0 \rightarrow \Lambda_c{}^+$ and $\Sigma_b{}^+ \rightarrow \Sigma_c{}^{++}$ are calculated. Also the heavy quark limit $m_Q \rightarrow \infty$ (Isgur-Wise symmetry) is examined. 28 refs.; 6 figs.; 3 tabs.

27786 (JINR-E-2-92-7) **Interference effects in inclusive charge-exchange p+p→n+X and n+p→p+X reactions at intermediate energies.** Gareev, F.A.; Ratis, Yu.L.; Korovin, P.P.; Strokovskij, E.A.; Vaagen, J.S. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Theoretical Physics. 1992. [18p.] Order Number DE93629991. Source: OSTI; NTIS (US Sales Only); INIS.

Submitted to Phys. Lett.

The formalism of Feynman diagrams to describe charge-exchange reactions p+p→n+X and n+p→p+X on a free proton target taking into account spectator and decay modes in the π+ρ+g'-model have used. It is shown that the interference between these modes depends on the set of vertex function parameters used. It is also shown that the constructive interference of the Δ^+ and Δ^0-isobars is important. 22 refs.; 10 figs.

27787 (JINR-E-2-92-234) **Conserved-vector-current hypothesis and the ν-bar$_e$e-bar→$\pi^-\pi^0$ process.** Dubnickova, A.Z. (Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Theoretical Physics); Dubnicka, S.; Rekalo, M.P. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Theoretical Physics. 1992. [14p.] Order Number DE93629984. Source: OSTI; NTIS (US Sales Only); INIS.

Submitted to Nucl. Phys.

Based on the conserved-vector-current (CVC) hypothesis and a four-ρ-resonance unitary and analytic vector dominance model of the pion electromagnetic form factor, the $\sigma_{tot}(E_\nu^{lab})$ and $d\sigma/dE_\pi^{lab}$ of the weak ν-bar$_e$e$^-\to\pi^-\pi^0$ process are predicted theoretically for the first time. Their experimental approval could verify the CVC hypothesis for all energies above the two-pion threshold. Since, unlike the electromagnetic $e^+e^-\to\pi^+\pi^-$ process, there is no isoscalar vector-meson contribution to the weak ν-bar$_e$e$^-\to\pi^-\pi^0$ reaction, accurate measurements of the $\sigma_{tot}(E_\nu^{lab})$ that moreover is strengthened with energy E_ν^{lab} linearly could solve the problem of the mass specification of the first excited state of the ρ (770) meson. An equality σ_{tot} (ν-bar$_e$e$^-\to\pi^-\pi^0$)=σ_{tot} ($e^+e^-\to\pi^-\pi^0$) is predicted for $\sqrt{s}\simeq 70$ GeV. 4 refs.; 5 figs.

27788 (LA–12559-T) **Inclusive measurements of pion double charge exchange and inelastic scattering on ^{3}He.** Yuly, M.E. Los Alamos National Lab., NM (United States). Jun 1993. 328p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93014377. Source: OSTI; NTIS; INIS; GPO Dep.

Thesis submitted to Massachusetts Inst. of Tech., Cambridge, MA.

A measurement was made at the Los Alamos Meson Physics Facility (LAMPF) of the doubly differential cross sections for three inclusive pion reactions on ^{3}He: π^- double charge exchange (DCX), and π^+ and π^- inelastic scattering. The cross sections for DCX were measured at incident energies of 120, 180, 210, and 240 MeV, and at angles of 25, 50, 80, 105, and 130°, while inelastic scattering cross sections were measured at 120, 180, and 240 MeV and scattering angles of 50, 80, 105, and 130°. The final pion energy spectrum was measured from 10 MeV up to the kinematic limit. In the Δ resonance region, where the isospin T = 3/2 channel dominates, the inelastic π^- scattering should be almost entirely from the lone neutron in ^{3}He. The π^+ inelastic scattering was expected to have significant contributions from both single and double scattering, because the T = 3/2 channel favors π^+-p scattering from the two protons in ^{3}He. The ^{3}He DCX spectra are similar to those observed for DCX in ^{4}He. The forward angle double peaks can be understood as a consequence of sequential single charge exchange (SSCX). Calculations using the SSCX model are in rough agreement with the measured shape of the ^{3}He DCX spectra. The doubly differential cross sections measured for the inelastic scattering reactions exhibit a strong enhancement near the kinematics for free π^--p scattering. The ratios of π^+ to π^- scattering cross sections may indicate multiple scattering, as well as the agreement of the low outgoing energy part of the π^+ inelastic scattering spectra with the corresponding properly scaled DCX spectra. A distorted-wave impulse-approximation (DWIA) calculation of the quasielastic cross sections has been performed and a comparison made with the measured inelastic cross sections.

27789 (LAL–92-09) **The perturbative QCD prediction to R_τ revisited.** Le Diberder, F. (Paris-11 Univ., 91 - Orsay (France). Lab. de l'Accelerateur Lineaire); Pich, A. Paris-11 Univ., 91 - Orsay (France). Lab. de l'Accelerateur Lineaire. Feb 1992. [17p.] (CERN-TH–6421/92.). Order Number DE93631844. Source: OSTI; NTIS (US Sales Only); INIS.

An improved QCD perturbative expansion of the total hadronic width of the tau lepton is presented. Within the framework of this revisited QCD prediction, the sensitivity of the extracted $\alpha_s(m_\tau^2)$ value to the unknown higher-order perturbative corrections and, more generally, the systematic error attached to the renormalization scheme ambiguity are reanalyzed. A more convergent perturbative expansion is proposed which is associated with a smaller renormalization-scheme dependence and better-defined higher-order uncertainties. (R.P.) 17 refs.; 4 figs.; 1 tab.

27790 (LA-UR–93-1292) **Rare muon processes.** Cooper, M.D. The MEGA Collaboration. Los Alamos National Lab., NM (United States). [1993]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930389–4: Future directions in particle and nuclear physics at multi-GeV hadron beam facilities, Upton, NY (United States), 4-6 Mar 1993). Order Number DE93012646. Source: OSTI; NTIS; INIS; GPO Dep.

The status of rare muon processes as tests of the standard model is reviewed with the emphasis on results that are expected from experiments in the near future.

27791 (LA-UR–93-1965) **Resonances in the ΣNN system.** Gibson, B.F. (Los Alamos National Lab., NM (United States)); Afnan, I.R. Brookhaven National Lab., Upton, NY (United States). [1993]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930389–14: Future directions in particle and nuclear physics at multi-GeV hadron beam facilities, Upton, NY (United States), 4-6 Mar 1993). Order Number DE93014353. Source: OSTI; NTIS; INIS; GPO Dep.

We first review certain unique aspects of few-body Λ- hypernuclei and then explore the physics of Σ threshold in few-body elastic scattering and reactions. In particular, we discuss a predicted enhancement in the Ad cross section near the ΣNN threshold in terms of poles in the T=0YNN amplitude. A brief discussion of anticipated poles in the T=1 amplitudes is also given.

27792 (LA-UR–93-1969) **Beauty and charm production from Fermilab experiment 789.** Jansen, D.M. (Los Alamos National Lab., NM (United States)); Boissevain, J.; Carey, T.A.; Jeppesen, R.G.; Kapustinsky, J.S.; Lane, D.W.; Leitch, M.J.; Lillberg, J.W.; McGaughey, P.L.; Moss, J.M.; Peng, J.C.; Brown, G.; Isenhower, L.D.; Keyser, J.; Sadler,.Los Alamos National Lab., NM (United States). [1993]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930363–1: 28. conference on quantum chromodynamics and high energy hadronic interactions, Les Arcs (France), 20-27 Mar 1993). Order Number DE93014351. Source: OSTI; NTIS; INIS; GPO Dep.

Experiment 789 is a fixed-target experiment at Fermilab designed to study low-multiplicity decays of charm and beauty. During the 1991 run. E789 collected $\approx 10^9$ events using an 800 GeV proton beam incident upon gold and beryllium targets. Analyses of these data include searches for b → J/ψ+X decays and Λ- dependence measurements of neutral D meson production. Preliminary results from the 1991 run are presented in this paper.

27793 (LA-UR–93-1970) **Present status of SAGE.** Bowles, T.J. For the SAGE Collaboration. Los Alamos National Lab., NM (United States). [1993]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930187–5: 13. Moriond workshop on perspectives in neutrinos, atomic physics, and gravitation, Villars-sur-Ollon (Switzerland), 30 Jan - 6 feb 1993). Order Number DE93014350. Source: OSTI; NTIS; GPO Dep.

A radiochemical ^{71}Ga-^{71}Ge experiment to determine the primary flux of neutrinos from the Sun began measurements of the solar neutrino flux at the Baksan Neutrino Observatory in 1990. The number of ^{71}Ge atoms extracted from 30 tons of gallium in 1990 and from 57 tons of gallium in 1991 was measured in twelve runs during the period of January 1990 to December 1991. The combined 1990 and 1991 data sets give a value of 58+17/−24 (stat) ±

14 (syst) SNU. This is to be compared with 132 SNU predicted by the Standard Solar Model.

27794 (LA-UR-93-2021) **Past, present and future (π,η) experiments.** Peng, J.C. Los Alamos National Lab., NM (United States). [1993]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930389-21: Future directions in particle and nuclear physics at multi-GeV hadron beam facilities, Upton, NY (United States), 4-6 Mar 1993). Order Number DE93016631. Source: OSTI; NTIS; INIS; GPO Dep.

Following a discussion of some physics issues in η experiments, the current status of the (π,η) experiments is reviewed. Future prospects for η experiments are also presented.

27795 (LBL-33952) **Status of α_s measurements.** Hinchliffe, I. Lawrence Berkeley Lab., CA (United States). 5 May 1993. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-9303171-2: 28. Recontres de Moriond conference on electroweak interaction and unified theories, Les Arcs (France), 13-20 Mar 1993). Order Number DE93015179. Source: OSTI; NTIS; INIS; GPO Dep.

I review the current determinations of α_s. Attention is given to the theoretical uncertainties inherent in most determinations. all current determinations are consistent with an average of $\alpha_s(M_Z) = 0.119 \pm 0.005$. Prospects for reduction of the errors in the future are discussed.

27796 (LBL-34077) **Electroweak physics from D0.** Roe, N.A. D0 Collaboration. Lawrence Berkeley Lab., CA (United States). May 1993. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-9303172-1: 1993 Recontres de Physique de La Vallee D'Aoste, LaThuile (Italy), 8-13 Mar 1993). Order Number DE93015041. Source: OSTI; NTIS; INIS; GPO Dep.

The D0 detector was recently commissioned at the Tevatron $p\bar{p}$ collider and is presently taking data. Preliminary results from D0 are presented on properties of the W and Z electroweak gauge bosons, using final states containing electrons and muons.

27797 (PCCF-T-92-09) **Experimental study of charm at LEP by the D* meson channel with ALEPH detector.** Bencheikh, A.M. Clermont-Ferrand-2 Univ., 63 - Aubiere (France). Lab. de Physique Corpusculaire. Sep 1992. [170p.] (In French). Order Number DE93631842. Source: OSTI; NTIS (US Sales Only); INIS.

This research deals with the analysis of some 500 000 neutral Z bosons recorded with the ALEPH detector between 1989 and 1991. The physical subject concerns the study of charm at LEP and more precisely the production of charmed mesons, charged and excited: D^*. Charged mesons are reconstructed in the channel with two pions and one kaon in the final state via the decay of neutral charmed one. We have measured simultaneously the ratio of D^* meson production, the relative contribution of charm and beauty in D^* meson production and the average fraction of the beam energy carried away by the D^* meson at the time of its fragmentation. The charge asymmetry of charm has been also measured thanks to the high purity in charm events obtained by the D^* tagging and finally allows us to infer the value of the electroweak mixing angle.

27798 (RAL-92-026) **Scalar mesons in ϕ radiative decay: Their implications for spectroscopy and for studies of CP-violation at ϕ factories.** Close, F.E. (Rutherford Appleton Lab., Chilton (United Kingdom)); Isgur, N.; Kumano, S. Rutherford Appleton Lab., Chilton (United Kingdom). Jun 1992. [27p.] (CEBAF-TH-92-13;IU/NTC-92-16.). Order Number DE93631843. Source: OSTI; NTIS (US Sales Only); INIS.

Existing predictions for the branching ratio for $\phi \rightarrow KK\ \gamma$ via $\phi \rightarrow S\ \gamma$ (where S denotes one of the scalar mesons $f_o(975)$ and $a_o(980)$) vary by several orders of magnitude. Given the importance of these processes for both hadron spectroscopy and charge-parity-violation studies at ϕ factories (where $\phi \rightarrow K^oK\text{-bar}^o\gamma$ poses a possible background problem), this state of affairs is very undesirable. We show that the variety of predictions is due in part to errors and in part to differences in modelling. The latter variation leads us to argue that the radiative decays of these scalar states are interesting in their own right and may offer unique insights into the nature of the scalar mesons. As a byproduct we find that the branching ratio for $\phi \rightarrow K^oK\text{-bar}^o\ \gamma$ is approx. $< 0(10^{-7})$ and will pose no significant background to proposed studies of CP-violation. (Author).

27799 (SLAC-PUB-5832) **An historical review of lepton proton scattering.** Taylor, R. Stanford Linear Accelerator Center, Menlo Park, CA (United States). Jun 1992. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00515. (CONF-910836-6: 19. Stanford Linear Accelerator Center (SLAC) summer institute on particle physics, Stanford, CA (United States), 5-16 Aug 1991). Order Number DE93015246. Source: OSTI; NTIS; INIS; GPO Dep.

In this talk I will try to review some of the early experiments in the field of electron-proton scattering, concentrating mostly on the inelastic scattering experiments at SLAC. Ordinarily, those experiments would be covered in the first five or ten minutes of the talks by Professor Scuilli and Drell, but this is a special year, and I will feel free to reminisce about the early days in a somewhat personal way.

27800 (UWThPh-1992-61) **General solution of Chew-Low equations for πN scattering in terms of θ-functions.** Meshcheryakov, D.V. (High Energy Physics and Quantum Theory Division, Physics Dept., Moscow State Univ., Leninskie Gory, 119899 Moscow (Russian Federation)). Vienna Univ. (Austria). Inst. fuer Theoretische Physik. 17 Nov 1992. [6p.] Order Number DE93628913. Source: OSTI; NTIS (US Sales Only); INIS.

General solution of Chew-Low equations for πN scattering in terms of θ-functions is obtained. Previously known solutions can be derived from the new one by limiting procedures. (author).

6624 Properties of Specific Particles and Resonances

Refer also to citation(s) 27762, 27764, 27765, 27766, 27768, 27770, 27777, 27793, 27794, 27796, 27822

27801 (BNL-48865) **Summary of the η-meson sessions.** Chrien, R.E. Brookhaven National Lab., Upton, NY (United States). [1993]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-930389-15: Future directions in particle and nuclear physics at multi-GeV hadron beam facilities, Upton, NY (United States), 4-6 Mar 1993). Order Number DE93014320. Source: OSTI; NTIS; INIS; GPO Dep.

This summary describes the contents of the nineteen talks related to research on the η meson and presented at the Workshop of Future Directions. The subjects of this area include threshold η production, η-nuclear spectroscopy, baryon spectroscopy, η decays, facilities, and instrumentation.

27802 (DOE/ER/40427-02-N93) **Measuring strangeness in the nucleon.** Henley, E.M. Washington Univ., Seattle, WA (United States). Dept. of Physics. [1992]. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG06-88ER40427. (CONF-9211243-1: 35. Congresso Nacional de Fisica, Puebla (Mexico), Nov 1992). Order Number DE93014861. Source: OSTI; NTIS; INIS; GPO Dep.

Evidence for strangeness matrix-elements in the proton are reviewed, and other measurements for specific strangeness matrix elements are presented.

27803 (JINR-E-2-92-3) **Scaling effects and properties of delta-isobar resonances.** Ratis, Yu.L.; Gareev, F.A. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Theoretical Physics. 1992. [8p.] Order Number DE93630004. Source: OSTI; NTIS (US Sales Only); INIS.

Submitted to Phys. Lett.

A simple model is suggested for the description of the delta-isobar gross properties based on the two-fold shape resonances. 7 refs.; 2 figs.; 1 tab.

27804 (JINR-E-2-92-88) **Method for determination of W-boson total width.** Ivkin, A.V. (AN Kazakhskoj SSR, Alma-Ata (Kazakhstan). Inst. Fiziki Vysokikh Ehnergij); Nazirov, M.T.; Kuraev, E.A. Joint Inst. for Nuclear Research, Dubna (Russian

Federation). Lab. of Theoretical Physics. 1992. [4p.] Order Number DE93630011. Source: OSTI; NTIS (US Sales Only); INIS.

Submitted to Mod. Phys. Lett. A.

A new way to measure the total width of a narrow resonance by total cross-section is proposed. The technique is exemplified in detail in the reactions $e^+e^- \rightarrow W^+W^-$, $\gamma e \rightarrow W\nu$. 5 refs.; 1 fig.; 1 tab.

27805 (LAL–92-59) **Higgs boson searches at LEP 1.** Grivaz, J.F. Paris-11 Univ., 91 - Orsay (France). Lab. de l'Accelerateur Lineaire. Oct 1992. [20p.] (CONF-9209363–: Workshop on 'Ten Years of Susy Confronting Experiment', Geneva (Switzerland), 7-9 Sep 1992). Order Number DE93631851. Source: OSTI; NTIS (US Sales Only); INIS.

The searches performed by the four LEP experiments for the minimal standard model Higgs boson and for the charged and neutral Higgs bosons expected in two-doublet models, in particular within the supersymmetric framework, are reviewed. The mass of the standard model Higgs boson exceeds 60 GeV/c^2 at more than 95% CL. Charged Higgs bosons with masses lower than 43 GeV/c^2 are excluded. The masses of the CP-even h and of the CP-odd A Higgs bosons of the MSSM are constrained to be larger than 43 GeV/c^2 and 21 GeV/^{2}, respectively. (author) 42 refs.; 6 figs.; 8 tabs.

27806 (LA-UR–93-1348) **On the 17-keV neutrino.** Hime, A. Los Alamos National Lab., NM (United States). Apr 1993. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9303160–1: Workshop on neutrino telescopes, Venice (Italy), 2-4 Mar 1993). Order Number DE93012638. Source: OSTI; NTIS; INIS; GPO Dep.

A brief review on the status of the 17-keV neutrino is presented. Several different experiments found spectral distortions which were consistently interpreted as evidence for a heavy neutrino admixture in β decay. Recent experiments, however, rule out the existence of a 17-keV neutrino as well as escaping criticisms of earlier null results. Moreover, the majority of positive results have been reinterpreted in terms of instrumental effects, despite the need for a different explanation in each case. Anomalies persist in the low energy region of the tritium spectrum which deserve further investigation.

27807 (PCCF-T–92-07) **Determination of nucleon structure functions on the assumption of diquark presence.** Tavernier, P. Savoie Univ., 73 - Chambery (France); Clermont-Ferrand-2 Univ., 63 - Aubiere (France). Lab. de Physique Corpusculaire. Jul 1992. [108p.] (In French). Order Number DE93631847. Source: OSTI; NTIS (US Sales Only); INIS.

In this thesis, we asked for the presence in the nucleons of either scalar or axial vector diquarks. After the introduction of the basis notions on diquarks and their interest in the understanding of various physical problems, we present in the first chapter the theoretical frame in SU(6) symmetry. Chapter 2 and 3 are respectively devoted to the Stockholm and Torino models. We point out to get a very nice fit of the experimental data with models we had to put in a small Q^2 dependence in the various quarks distribution functions previously determined. In chapter 4, we used our distribution functions and compared our predictions with experimental results: the ratio of the neutron electromagnetic structure function to that of the proton, the ratio of the longitudinal component to the transverse one for the lepton-nucleon scattering cross-section, so the dileptons production in Drell-Yan process. The conclusion of that study is that the presence of diquarks does not lead, at the moment, to any obvious contradiction with the experimental data; diquarks as constituents are a viable idea, which in certain kinematical regions could be of crucial importance.

27808 (RAL–92-070) **New data on the KK-bar threshold region and the nature of the $f_0(S^*)$.** Morgan, D. (Rutherford Appleton Lab., Chilton (United Kingdom)); Pennington, M.R. Rutherford Appleton Lab., Chilton (United Kingdom). Dec 1992. [53p.] (DTP–92/55.). Order Number DE93631849. Source: OSTI; NTIS (US Sales Only); INIS.

We combine new data on $f_0(S^*)$ production in J/ψ and D_s decays with earlier information on central production and elastic $\pi\pi$, KK-bar processes to make a fresh examination of the $f_0(S^*)$ resonance. The key feature of our amplitude analysis is its strict enforcement of unitarity. This allows the good energy resolution of the new $J/\psi \rightarrow \phi\pi\pi$(KK-bar) data to play its full role in delineating the $f_0(S^*)$ resonance structure that experiment demands. This enables us to distinguish alternative resonance mechanisms that have been proposed: we conclude that $f_0(S^*)$ is most probably not a KK-bar molecule, nor an amalgam of two resonances, but a conventional Breit-Wigner-like structure. In this preferred description, the $f_0(S^*)$ has rather a narrow width ($\Gamma_0 \approx 52$ MeV) and comparable couplings to $\pi\pi$ and KKbar. Possible spectroscopic interpretations are considered. (Author).

6630 Nuclear Physics

Refer also to citation(s) 27037

27809 (CONF-9210367–1) **Detector frontier: Theoretical expectations and dreams.** Nazarewicz, W. Joint Inst. for Heavy Ion Research, Oak Ridge, TN (United States); Tennessee Univ., Knoxville, TN (United States). Dept. of Physics. [1992]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400 ;FG05-93ER40770 ;FG05-87ER40361. From International seminar on the frontier of nuclear spectroscopy; Kyoto (Japan); 23-24 Oct 1992. Order Number DE93015814. Source: OSTI; NTIS; INIS; GPO Dep.

The new large detector systems are certain to shed new light on many aspects of nuclear structure. Some of these areas for future studies are discussed. In this contribution the author concentrates on several aspects of nuclear spectroscopy, that will be accessible by modern detector systems (e.g., γ-ray crystal balls or new-generation particle detectors).

27810 (UCRL-JC–110651) **Some tools of the trade we've developed for our cross-section calculations.** Gardner, D.G.; Gardner, M.A. Lawrence Livermore National Lab., CA (United States). Nov 1992. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-921046–19: Symposium on nuclear data evaluation methodology, Upton, NY (United States), 12-16 Oct 1992). Order Number DE93013835. Source: OSTI; NTIS; INIS; GPO Dep.

A number of compute codes have been modified or developed, both main-frame and PC. Seven codes, of which three are discussed in some detail. The later are: a controller-driven, double-precision version of the coupled-channel code ECIS; the latest version of STAPRE, a precompound plus Hauser-Feshbach nuclear reaction code; and NUSTART, a PC code that analyzes large sets of discrete nuclear levels and the multipole transitions among them. All main-frame codes are now being converted to the UNICOS operating system.

6631 Nuclear Structure

Refer also to citation(s) 27747, 27791, 27830, 27836

27811 (BNL–48879) **Strange particle nuclear physics: Workshop summary.** Dover, C.B. Brookhaven National Lab., Upton, NY (United States). Mar 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-930389–17: Future directions in particle and nuclear physics at multi-GeV hadron beam facilities, Upton, NY (United States), 4-6 Mar 1993). Order Number DE93014323. Source: OSTI; NTIS; INIS; GPO Dep.

Several sessions of the Working Group on Hadronic and Nuclear Spectroscopy dealt with different aspects of strange particle nuclear physics, including hypernuclear spectroscopy, strange dibaryons, and K^+ interactions with nuclei. Recent developments in this area are summarized here, and open questions are identified. Some prospects for optimum use of existing facilities, as well as the desired characteristics of future ones, are discussed.

27812 (BNL–48886) **Doubly strange hypernuclei.** May, M. Brookhaven National Lab., Upton, NY (United States). [1993]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-930389–16: Future directions in particle and nuclear physics at multi-GeV hadron beam facilities, Upton, NY (United States), 4-6 Mar 1993). Order Number DE93014324. Source: OSTI; NTIS; INIS; GPO Dep.

Doubly strange hypernuclei are fundamental for understanding proposed new particles and states of matter containing two or more units of strangeness. Experiments are required to confirm the existence of $\Lambda\Lambda$ hypernuclei, measure their lifetimes, binding energies, and decay modes, and search for possible anomalies. An experiment to observe and study them is planned utilizing the higher intensity beams now available at the AGS. Detailed study will require further improvements in intensity and facilities. Facility requirements for future experiments are discussed.

27813 (CONF-920721–16) **Deformation studies in the extremely neutron-deficient praseodymium, neodymium and promethium isotopes.** Breitenbach, J. (Georgia Inst. of Tech., Atlanta, GA (United States)); Braga, R.A.; Wood, J.L.; Semmes, P.B.; Kormicki, J. Oak Ridge National Lab., TN (United States); Georgia Inst. of Tech., Atlanta, GA (United States); UNISOR, Oak Ridge, TN (United States). [1992]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-87ER40330 ;AC05-76OR00033 ;AC05-84OR21400. From 6. international conference on nuclei far from stability and 9th international conference on atomic masses and fundamental constants; Bernkastel-Kues (Germany); 19-24 Jul 1992. Order Number DE93015337. Source: OSTI; NTIS; INIS; GPO Dep.

Several experiments were performed at the UNISOR isotope separator facility at HHIRF at the Oak Ridge National Laboratory on the β^+/EC decay of neutron-deficient rare earth isotopes. Data for the three decay chains $^{137}Eu \rightarrow {}^{137}Sm \rightarrow {}^{137}Pm \rightarrow {}^{137}Nd$, $^{135}Sm \rightarrow {}^{135}Pm \rightarrow {}^{135}Nd$ and $^{133}Sm \rightarrow {}^{133}Pm \rightarrow {}^{133}Nd$ were obtained consisting of multiscaled spectra of γ rays, x rays, and conversion electrons, as well as $\gamma\gamma t$, $X\gamma t$, $e\gamma t$ and eXt coincidences. Gamma rays associated with the decay of ^{133}Sm and ^{133}Pm were observed for the first time. The decay of a new low-spin (1/2,3/2) isomeric state, with a half life around 70 sec was seen in ^{133}Nd. Systematics and particle-rotor calculations are discussed.

27814 (CONF-9211199–8) **Low-spin identical bands in rare earth nuclei.** Baktash, C.; Winchell, D.F.; Garrett, J.D.; Smith, A. Oak Ridge National Lab., TN (United States). [1992]. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Symposium on nuclear physics of our times; Sanibel Island, FL (United States); 17-21 Nov 1992. Order Number DE93015484. Source: OSTI; NTIS; INIS; GPO Dep.

A comprehensive study of odd-A rotational bands in normally deformed rare earth nuclei indicates that a large number of seniority-one configurations (21% for odd-Z nuclei) at low spin have moments of inertia nearly identical to that of the seniority-zero configuration of the neighboring even-even nucleus with one less nucleon. It is difficult to reconcile these results with conventional models of nuclear pair correlation, which predict variations of about 15% in the moments of inertia of configurations differing by one unit in seniority.

27815 (CONF-921274–1) **Exotic nuclei.** Sheikh, J.A. (Joint Inst. for Heavy Ion Research, Oak Ridge, TN (United States)). Joint Inst. for Heavy Ion Research, Oak Ridge, TN (United States); Tata Inst. of Fundamental Research, Bombay (India). [1992]. 53p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Symposium on nuclear physics organized by Department of Atomic Energy (DAE); Bombay (India); 21-24 Dec 1992. Order Number DE93012763. Source: OSTI; NTIS; INIS; GPO Dep.

The nuclei far from the β-stability valley which are referred to as exotic nuclei have attracted considerable interest in recent years. Undoubtedly the study of the exotic nuclei is destined to be one of the frontier fields in nuclear structure physics. The recent experiments with radioactive beams have opened up this new era in nuclear spectroscopy. The lighter exotic nuclei are observed to show quite interesting features. For example, a halo structure has been attributed to ^{11}Li in order to explain the observed large matter radius. Also, it is seen that $^{31--33}Na$ show deformed characteristics rather than the spherical shape expected from the shell closure at N = 20. This points towards a need for a new investigation of the shell structure as one moves away from the β – stability valley. With the aforementioned interesting features observed for the lighter nuclei, clearly one question of great interest is whether similar effects can be seen in heavy nuclei. New calculations using the relativistic mean field approach have been performed for a range of nuclei over a wide range of isotopes up to those with a large excess of neutrons. In the present talk, some interesting new results obtained from these calculations win be discussed.

27816 (CONF-9303189–1) **The role of nuclear shapes in nuclear structure (from the perspective of the Daresbury Tandem).** Nazarewicz, W. Joint Inst. for Heavy Ion Research, Oak Ridge, TN (United States); Tennessee Univ., Knoxville, TN (United States). Dept. of Physics. [1993]. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400 ;FG05-87ER40361 ;FG05-93ER40770. From Requiem for an accelerator conference; Daresbury (United Kingdom); 13-14 Mar 1993. Order Number DE93015805. Source: OSTI; NTIS; INIS; GPO Dep.

In specific regions of the nuclear periodic chart, large multipole moments are observed and the low-lying excitations have a rotational character. These features are understood if the nuclei in question are assumed to have a stable deformation, i.e., a non-spherical distribution of the nuclear matter. In other (transitional) regions the quasi-rotational bands are present; they are strongly coupled to low-lying vibrational modes. Those nuclei are best understood in terms of small static deformations but large dynamic fluctuations around local equilibria. As a matter of fact, the vast majority of nuclei are deformed; even in those which are spherical or almost spherical, the dynamical couplings to shape vibrations are crucial. The issue of nuclear deformation is many-faceted. If the nuclear shape (nuclear mean field) is deformed, characteristic excitation modes are present, such as rotations and vibrations built upon the non-spherical equilibrium. Through the particle-core coupling, nuclear deformations can dramatically influence the single-particle properties of nucleons moving in the average nuclear potential. Many experimental investigations using the Daresbury Tandem were related in one way or another to the physics of nuclear shapes. Fundamental discoveries from Daresbury include the observation of superdeformed structures in rapidly rotating nuclei, the observation of identical ("twinned") rotational bands, various studies of structural changes induced by very fast rotation (band-crossings, band-terminations), the observation of the oblate-deformed "dipole" bands, studies of reflection-asymmetric shapes, studies of (quasimolecular) cluster configurations in light nuclei, and many, many others. The author reviews the forefront research at Daresbury from the global perspective; the common denominator being the nuclear shape deformation.

27817 (DOE/FTR–93011417) **Travel to Belgium to attend a meeting of the IAEA International Nuclear Structure Data Network and to inspect facilities for the measurement of neutron cross sections in Belgium and Germany: Foreign trip report, November 8–16, 1992.** Meyer, R.A. USDOE Office of Energy Research, Washington, DC (United States). Office of High Energy and Nuclear Physics. 2 Dec 1992. 5p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93011417. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Proceedings and action items from the meeting of the IAEA International Nuclear Structure Data Network are summarized. Visits to the CENMol accelerator facility, that performs neutron cross section measurements, and to the PTB-Braunschweig accelerator facility that is used for neutron calibration and cross section measurements, are briefly described.

27818 (GANIL-P–92-24) **Simulating the Langevin force by simple noise in nuclear one-body dynamics.** Chomaz, Ph. (Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France)); Colonna, M.; Burgio, G.F.; Toro, M. Di; Randrup, J. Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France). 1992. [13p.] Order Number DE93631859. Source: OSTI; NTIS (US Sales Only); INIS.

For the purpose of addressing catastrophic phenomena in nuclear dynamics, the possibility of simulating the stochastic part of the collision integral is explored in the Boltzmann-Langevin model by the numerical noise associated with the finite number of test particles in the ordinary BUU treatment. Considering idealized two-dimensional matter, for which it is practical to simulate the Boltzmann-Langevin equation directly, it is demonstrated that the number of test-particles per nucleon can be adjusted so that the corresponding BUU calculation yields a good reproduction of the

spontaneous clusterization occurring inside the spinodal region. This approximate method may therefore provide a relatively easy way to introduce meaningful fluctuations in simulations of unstable nuclear dynamics. (author) 18 refs.; 3 figs.

27819 (GANIL-P–93-02) **Pre-equilibrium effects on properties of hot giant dipole resonances.** Chomaz, Ph. (Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France)); Di Toro, M.; Smerzi, A. Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France). 1993. [24p.] Order Number DE93631855. Source: OSTI; NTIS (US Sales Only); INIS.

In this article we analyse how the presence of a pre-equilibrium dipole strength can affect the properties of the Giant Dipole Resonance (GDR) built on hot nuclei. We show that a little amount of GDR phonons still excited when the compound nucleus is formed will substantially modify the γ decay from the giant resonance region. Also on the basis of microscopic calculations of the reaction dynamics we propose to study the effect of the N over Z ratio in the entrance channel. This analysis could bring to independent informations on the problem of the GDR disappearing at high excitation energy.

27820 (INS-T–518) **Report of an INS two-day meeting on roles of Pauli principle in few-body problems: Discussions with Prof. V.I. Kukulin.** Kamimura, M. (ed.) (Kyushu Univ., Fukuoka (Japan). Dept. of Physics). Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study. Feb 1993. 74p. (CONF-9110505–: INS two-day meeting on roles of Pauli principle in few-body problems, Tanashi (Japan), 30-31 Oct 1991). Order Number DE93508341. Source: OSTI; NTIS; INIS.

This small INS meeting on 'Roles of Pauli Principle in Few-Body Systems' was held on Oct. 30-31, 1991. A lecture was given by Prof. V.I. Kukulin (Moscow State University) on new physics with the quark-based Moscow N-N potential for few-nucleon systems and on microscopic studies of multi-cluster systems. Seven other speakers gave talks on various roles of the Pauli principle in few-body systems, in multi-cluster systems and in heavy-ion reactions. (J.P.N.).

27821 (JINR-R–4-92-253) **Influence of quantum effects and interaction nonlocality on the 3^-, 2^- and 1^- excitations.** Bal'butsev, E.B.; Molodtsova, I.V.; Unzhakova, A.V. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Theoretical Physics. 1992. [14p.] (In Russian). Order Number DE93630012. Source: OSTI; NTIS (US Sales Only); INIS.

Submitted to Yad. Fiz.

The method of Wigner function moments is applied to calculate energies and excitation probabilities of 3^-, 2^- and 1^- states with Skyrme forces. Two possible parametrisations of currents, the role of quantum corrections to Vlasov equation and the problem of the so-called 'nested' equations are investigated. 13 refs.; 4 figs.; 2 tabs.

27822 (LBL–33031) **Relativistic mean-field calculations of Λ and Σ hypernuclei.** Glendenning, N.K. (Lawrence Berkeley Lab., CA (United States)); Von-Eiff, D.; Haft, M.; Lenske, H.; Weigel, M.K. Lawrence Berkeley Lab., CA (United States). 24 Oct 1992. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. Order Number DE93015269. Source: OSTI; NTIS; GPO Dep.

Single-particle spectra of Λ and Σ hypernuclei are calculated within a relativistic mean-field theory. The hyperon couplings used are compatible with the Λ binding in saturated nuclear matter, neutron-star masses and experimental data on Λ levels in hypernuclei. Special attention is devoted to the spin-orbit potential for the hyperons and the influence of the ρ-meson field (isospin dependent interaction).

6632 Radioactivity and Electromagnetic Transitions (Excluding Fission)

Refer also to citation(s) 27178, 27830, 28209

27823 (IPNO-DRE–92-36) **Spectroscopic measurements using isotope separator on-line facilities.** Sauvage, J. Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire. 1992. [22p.] (CONF-9210368–: 6. Franco-Japanese Colloquium on nuclear structures and inter-disciplinary topics, St. Malo (France), 6-10 Oct 1992). Order Number DE93628658. Source: OSTI; NTIS (US Sales Only); INIS.

Isotope Separator On-Line facilities (such as ISOCELE, IGISOL and ISOLDE) together with some detection techniques are briefly described. Results concerning soft nuclei located around A = 120 and A = 186 are discussed stressing similarities and differences. The comparison of theoretical and experimental results on γ - vibrational bands in Hg isotopes is presented. The existence of an abnormal M1 transition in ^{187} Pt is discussed. The work on microweight quantities of ^{178m2} Hg is touched upon.

27824 (LA-UR–93-1971) **Angular correlations in neutron beta decay.** Bowles, T.J. Los Alamos National Lab., NM (United States). [1993]. 22p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9301111–1: Colloquium in honor of Walter Mampe, Grenoble (France), 29 Jan 1993). Order Number DE93014349. Source: OSTI; NTIS; INIS; GPO Dep.

This paper discusses a new generation experiment searching for time reversal violation in polarized neutron beta decay.

27825 (LBL–33904) **Thick-target yields of iodine isotopes from proton interactions in Te, and the double-β decay of ^{128,130}Te.** da Cruz, M.T.F. (Lawrence Berkeley Lab., CA (United States)); Chan, Y.D.; Garcia, A.; Larimer, R.M.; Lesko, K.T.; Norman, E.B.; Rossi, D.F.; Stokstad, R.G.; Zlimen, I.; Wietfeldt, F.E.; Bardayan, D.W.; Hindi, M.M. Lawrence Berkeley Lab., CA (United States). 29 Mar 1993. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-930779–14: International cosmic-ray conference, Calgary (Canada), 19-20 Jul 1993). Order Number DE93013914. Source: OSTI; NTIS; INIS; GPO Dep.

We report thick-target yields of ^{126,128,130}I from the bombardment of natural Te targets with 15-, 30-, 45- and 50-MeV protons, together with the iodine production cross sections for 1.85- and 5.0-GeV protons. With these data, we have estimated the relative cosmic-ray induced production of ^{126}Xe, ^{128}Xe and ^{130}Xe in Te ores. These quantities affect the ratio of double-β decay half-lives of ^{130}Te and ^{128}Te. A revised correction of cosmic-ray induced xenon can change the half-life ratio by as much as 10%, from $(3.52\pm0.11) \times 10^{-4}$ to $(3.88\pm0.14) \times 10^{-4}$.

27826 (ORNL/FTR–4353) **Travel to Germany for conference on nuclei far from stability and conference on atomic masses and fundamental constants: Foreign trip report, July 18–26, 1992.** Toth, K.S. Oak Ridge National Lab., TN (United States). 5 Aug 1992. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93013006. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report presents a summary of the activities of the traveler and information derived while participating in the joint meeting of the Sixth International Conference on Nuclei Far From Stability and of the Ninth International Conference on Atomic Masses and Fundamental Constants, Bernkastel-Kues, Germany.

6633 Nuclear Reactions and Scattering, General

Refer also to citation(s) 27747

27827 (CONF-921046–21) **Approximate methods for derivation of covariance data.** Tagesen, S. (Vienna Univ. (Austria). Inst. fuer Radiumforschung und Kernphysik); Larson, D.C. Oak Ridge National Lab., TN (United States). [1992]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Symposium on nuclear data evaluation methodology; Upton, NY (United States); 12-16 Oct 1992. Order Number DE93015969. Source: OSTI; NTIS; INIS; GPO Dep.

Several approaches for the derivation of covariance information for evaluated nuclear data files (EFF2 and ENDF/B-VI) have been developed and used at IRK and ORNL respectively. Considerations, governing the choice of a distinct method depending on the quantity and quality of available data are presented, advantages/disadvantages are discussed and examples of results are given.

27828 (DOE/ER/40768–1) **The theory of relativistic heavy ion collisions: Progress report.** State Univ. of New York, Stony Brook, NY (United States). Dept. of Physics. Jul 1993. 38p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-93ER40768. Order Number DE93015934. Source: OSTI; NTIS; INIS; GPO Dep.

This program began in January 1993. Its primary goals are studies of highly excited matter and its production in nuclear collisions at very high energies. After a general orientation on the project, abstracts describing the contents of completed papers and providing some details of current projects are given. Principal topics of interest are the following: the dynamics of nuclear collisions at very high energies (RHIC and LHC), the dynamics of nuclear collisions at AGS energies, high-temperature QCD and the physics of the quark-gluon plasma, and the production of strangelets and other rare objects.

27829 (GANIL-P–92-22) **The fragmentation-inactivation binary model.** Botet, R. (Paris-11 Univ., 91 - Orsay (France). Lab. de Physique des Solides); Ploszajczak, M. Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France). 1992. [18p.] Order Number DE93631866. Source: OSTI; NTIS (US Sales Only); INIS.

A novel fragmentation model is developed in which the fragmentation cascade is randomly inactivated according to the homogeneous inactivation probability function. For the multiplicative break-up kernel $F_{i,j}=(ij)^{\alpha}$, the existence of scaling solution as $t \rightarrow \infty$ in different regions of the phase-diagram is discussed. Fluctuations in the cluster-size distribution is also studied, and an intermittent behavior is found in the infinite-cluster phase and at the transition line. The relevance of this model for nuclear multifragmentation is discussed. (K. A.) 16 refs.; 4 figs.

6634 Specific Nuclear Reactions and Scattering

Refer also to citation(s) 26968, 26988, 27817, 27825, 27871, 28028, 28211

27830 (ANL/PHY/CP–79497) **Research at the Fragment Mass Analyzer at ATLAS.** Davids, C.N. (Argonne National Lab., IL (United States)); Back, B.; Carpenter, M.P.; Freer, M.; Henderson, D.J.; Henry, R.G.; Janssens, R.V.F.; Khoo, T.L.; Lauritsen, T.; Liang, Y.; Wuosmaa, A.H.; Bearden, I.G.; Daly, P.J.; Fornal, B.; Grabowski, Z.W.; MayArgonne National Lab., IL (United States). [1993]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9305203–1: International school seminar on heavy ion physics, Dubna (Russian Federation), 10-15 May 1993). Order Number DE93015144. Source: OSTI; NTIS; INIS; GPO Dep.

The experimental program at the Fragment Mass Analyzer (FMA) at the ATLAS accelerator is well under way. Experiments have been carried out at the target position and at the focal plane. After a brief facility description, some recent experimental results are presented.

27831 (BNL–48694) **Baryon distributions in heavy ion collisions at AGS energies: An experimental overview.** Videbaek, F. Brookhaven National Lab., Upton, NY (United States). [1993]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-930173–8: HIPAGS meeting, Cambridge, MA (United States), 14-17 Jan 1993). Order Number DE93014045. Source: OSTI; NTIS; INIS; GPO Dep.

Data on rapidity distributions of protons from the three AGS experiments E-814, E-810 and E-802 are compared on a common base to enlarge the rapidity coverage. Together they provide a unique opportunity to study the proton distributions in relativistic heavy ion reactions over the full rapidity range. Systematics of the rapidity density distributions are presented as function of centrality and mass of colliding system. Considerable stopping is achieved for the heaviest system studied, Au+Au, thus giving the means to study high-density effects in nuclear matter.

27832 (BNL–48880) **Meson interferometry in relativistic heavy ion collisions.** Brookhaven National Lab., Upton, NY (United States). 1993. 211p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-9304122–: Meson interferometry in relativistic heavy ion collisions, Upton, NY (United States), 16-17 Apr 1993). Order Number DE93013143. Source: OSTI; NTIS; INIS; GPO Dep.

This report contains discussions on the following topics: Recent HBT results form CERN experiment NA44; interferometry results from E802/E859/E866; recent results on two particle correlations from E814; source sizes from CERN data; intermittency and interferometry; Bose-Einstein correlations in 200A GeV S+Au collisions; HBT correlations at STAR; HBT interferometry with PHENIX; HBT calculations from ARC; three pion correlations; and pion correlations in proton-induced reactions.

27833 (BNL–48888) **Physics at the AGS with a relativistic cascade.** Kahana, S.H.; Pang, Yang; Schlagel, T.J. Brookhaven National Lab., Upton, NY (United States). Feb 1993. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-930173–10: HIPAGS meeting, Cambridge, MA (United States), 14-17 Jan 1993). Order Number DE93014292. Source: OSTI; NTIS; INIS; GPO Dep.

The relativistic cascade code ARC is applied to the results from heavy ion collisions, at a laboratory energy of 14.6 GeV/c per nucleon, for a variety of projectiles and targets. A detailed discussion is given of the physics and inputs of this cascade. No deviation between ARC and experiment has yet been identified as a possible signal of collective hadronic behaviour.

27834 (BNL–70173) **Purpose of the trip was to hold discussions with several institutions in Russia on their prospective collaboration with the PHENIX experiment at the BNL Relativistic Heavy Ion Collider (RHIC): Foreign trip report, March 29, 1992–April 4, 1992.** Aronson, S.H. Brookhaven National Lab., Upton, NY (United States). 8 Jul 1992. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. Order Number DE93013815. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The report describes discussions with scientific representatives of four research laboratories in Russia which had previously indicated interest in participating in PHENIX, an experiment at RHIC which focuses on dilepton and direct photon signals of the Quark-Gluon Plasma (QGP). Some tentative agreements were reached with these institutions concerning their collaboration in PHENIK. Issues were identified with require further discussion in the process of completing official agreements.

27835 (CEA-LNS-Ph–92-04) **Subthreshold inclusive η production in nuclei by 1 GeV protons.** Chiavassa, E. (Istituto Nazionale di Fisica Nucleare, Turin (Italy)); Dellacasa, G.; Marco, N. de; Ferrero, F.; Musso, A.; Piccotti, A.; Scomparin, E.; Vercellin, E.; Gallio, M.; Bertini, R.; Durand, J.M.; Brochard, F. Laboratoire National Saturne - Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). 1992. [18p.] Order Number DE93631870. Source: OSTI; NTIS (US Sales Only); INIS.

Submitted to Zeitschrift fuer Physik, A (DE).

The doubly differential cross-section for the η production in the reaction $p+A \rightarrow X+\eta$ has been measured on ^{6}Li, C, Al, Cu and Au targets using a proton beam of 1 GeV kinetic energy of the Saturne protosynchrotron in Saclay. η mesons were detected by a two arm neutral meson spectrometer, PINOT. The A dependence of the doubly differential production cross-section is provided and is compared to theoretical predictions. (author) 19 refs.; 4 figs.

27836 (CONF-920721–15) **High spin states in neutron rich nuclei from spontaneous fission.** Butler-Moore, K. (Vanderbilt Univ., Nashville, TN (United States). Dept. of Physics); Zhu, S.; Zhao, X.; Hamilton, J.H.; Ramayya, A.V.; Lu, Q.; Ma, W.C.; Peker, L.K.; Kormicki, J.; Deng, J.K.; Gore, P.; Shi, D.; Jones, E.F.; Xie, H.; Gao, W.B.; Cole, J.D.;Vanderbilt Univ., Nashville, TN (United States). Dept. of Physics; Oak Ridge National Lab., TN (United States). [1992]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-88ER40407 ;AC05-84OR21400. From 6. international conference on nuclei far from stability and 9th international conference on atomic masses and fundamental constants; Bernkastel-Kues (Germany); 19-24 Jul 1992. Order Number DE93013889. Source: OSTI; NTIS; INIS; GPO Dep.

One fragment-γ-γ and three γ-γ coincidence measurements of the prompt γ-rays from the fragments produced in the spontaneous fission (SF) of ^{252}Cf and very recently of ^{242}Pu were carried out with a 20 Ge detector ball at HHIRF. With our high statistics, γ-γ-γ coincidences where the two gates are on transitions in the two partner fragments were extracted. Comparing the ^{252}Cf and ^{242}Pu data allowed unique placements of many transitions. New, higher spin states were observed in many nuclei, up to 16$^+$ in some of the heavy partners. Levels in several nuclei were observed for the full time. Studies of the fission process included measured relative branchings to the 1n to 6n channels. Much data remains to be analyzed. These data provide new insights into the changing structures at higher spins of many neutron-rich nuclei and the fission process.

27837 (CONF-9210173–6) **Covariance matrix of model parameters and uncertainties of calculated neutron cross sections on ^{19}F.** Zhao, Zhixiang (Academia Sinica, Beijing, BJ (China). Inst. of Atomic Energy); Fu, C.Y.; Larson, D.C. Oak Ridge National Lab., TN (United States). [1992]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Nuclear Energy Agency Science Committee (NEANSC) specialists meeting on evaluation and processing of covariance data; Oak Ridge, TN (United States); 7-9 Oct 1992. Order Number DE93015798. Source: OSTI; NTIS; INIS; GPO Dep.

A simplified method to estimate covariance matrix the model parameters is presented in this work and applied to calculate covariance matrix of calculated cross sections on ^{19}F.

27838 (CRN–92-09) **Preequilibrium to evaporation residues: dynamical approach to intermediate energy nucleus-nucleus collisions.** Krishan, K. (Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires); Wagner, P.; Coffin, J.P.; Rami, F.; Bhattacharya, S. Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires. [1992]. [29p.] Order Number DE93631881. Source: OSTI; NTIS (US Sales Only); INIS.

Submitted to Physical Review, C (US).

Dynamical evolution of the nucleus-nucleus collisions in the Fermi energy domain is followed from the point of interaction to the evaporation residues on event by event basis by Monte-Carlo simulation technique. The complete reaction process comprises two phases, (i) the preequilibrium phase and (ii) the evaporation phase. The initial preequilibrium phase leads to the formation of an incompletely fused composite which, assumed to be thermally equilibrated, subsequently decays leading to final residues. The calculations are parameter free. The calculated inclusive residue charge distribution, exclusive proton and α-particle spectra and other physical observables for the reaction ^{40}Ar + ^{24}Mg and ^{40}Ar + ^{13}C at 1100 MeV are compared with the respective experimental data. The theoretical predictions are found to be in good agreement with the experimental results. (author) 15 refs.; 8 figs.

27839 (CRN–92-27) **Resonant and nonresonant behavior of the heavy-ion reaction ^{14}C + ^{12}C.** Freeman, R.M. (Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires); Haas, F.; Youlal, M.; Hachem, A.; Monnehan, G.A.; Basrak, Z. Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires. [1992]. [34p.] Order Number DE93631882. Source: OSTI; NTIS (US Sales Only); INIS.

Submitted to Physical Review, C (US).

The ^{14}C + ^{12}C reaction has been studied by a kinematic coincidence technique at 13 incident energies ranging from $E_{c.m.}$=19.35 to 24.9 MeV. The resonances previously reported from γ-ray yield measurements were observed in the equivalent excitation functions, as well as in the large angle elastic scattering data, of the present measurements. Spin assignments were made to the two resonances in this energy range. These resonances are members of a band with angular momenta several units larger than the grazing values corresponding to ^{14}C and ^{12}C orbiting about each other at a distance significantly outside the strong absorption radius. Other structures which were observed were unrelated to the resonant behavior. (author) 22 refs.; 14 figs.

27840 (CRN–92-43) **Folding model analysis of ^{58}Ni + ^{64}Ni elastic and inelastic scattering at E_{lab}=203.8 and 219.2 MeV.** Ruiz, J.A. (Valencia Univ. (Spain). Inst. de Fisica Corpuscular); Ferrero, J.L.; Bilwes, B.; Bilwes, R. Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires. 1992. [25p.] Order Number DE93631883. Source: OSTI; NTIS (US Sales Only); INIS.

Submitted to Nuclear Physics (US).

Angular distributions of elastic scattering of ^{58}Ni by ^{64}Ni and inelastic scattering leading to the first 2$^+$ state in ^{58}Ni or in ^{64}Ni were measured at E_{lab}=203.8 and 219.2 MeV. The data were analyzed in the frame of the folding model. A renormalization N of the folding potential consistently lower than unity (N≈0.65) is needed to reproduce the elastic scattering data. Coupled-channel calculations including the main inelastic channels explain partly this discrepancy. They reproduce the elastic and inelastic scattering data with a renormalization of N≈0.8 at both energies. Interference between Coulomb and nuclear excitation is shown to play an important role in the repulsive character of the polarization potential. (author) 38 refs.; 6 figs.; 1 tab.

27841 (GANIL-P–92-07) **K$^+$ production far below the free nucleon-nucleon threshold in heavy-ion collisions.** Belkacem, M. (Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France)); Suraud, E.; Ayik, S. Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France). [1992]. [12p.] Order Number DE93631884. Source: OSTI; NTIS (US Sales Only); INIS.

The K$^+$ production cross-section far below the free nucleon-nucleon production threshold is estimated in ^{12}C + ^{12}C collisions using simulations of the Boltzmann and the Boltzmann-Langevin equations. Fluctuations increase substantially the cross-sections especially at low beam energies. An estimate of the K$^+$ yield in ^{42}Ca + ^{42}Ca collisions at an incident energy of 90 MeV/n is also given, in order to compare these result to recent experimental data obtained in a similar system by Julien et al. (author) 14 refs.; 2 figs.; 2 tabs.

27842 (GANIL-P–92-15) **Static aspects of the fission and fusion of liquid ^{3}He drops.** Guilleumas, M. (Barcelona Univ. (Spain). Facultad de Fisica); Barranco, M.; Pi, M.; Garcias, F.; Suraud, E. Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France). [1992]. [26p.] Order Number DE93631876. Source: OSTI; NTIS (US Sales Only); INIS.

Submitted to Zeitschrift fuer Physik, D (DE).

Using an effective ^{3}He-^{3}He interaction, the fission and fusion of ^{3}He drops have been investigated from a static point of view. The calculations show that a fission barrier develops for these neutral systems, and that their saddle configurations are rather elongate. The transition from oblate to prolate shapes as a function of the angular momentum L, as well as critical values for fission and fusion are discussed for some selected cases. A kind of proximity potential can be extracted from the drop-drop interaction potentials. (author) 33 refs.; 9 figs.

27843 (GANIL-P–92-17) **Fission of spin-aligned projectile-like nuclei in the interactions of 29 MeV/nucleon ^{208}Pb with ^{197}Au.** Bresson, S. (Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France)); Morjean, M.; Jastrzebski, J.; Skulski, W.; Bougault, R.; Colin, J.; Horn, D.; Gatty, B. Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France). [1992]. [14p.] Order Number DE93631896. Source: OSTI; NTIS (US Sales Only); INIS.

Submitted to Physics Letters, B. (NL).

Binary fission of projectile-like nuclei was investigated in the interaction of 29 MeV/nucleon Pb on Au, together with the associated neutron multiplicity. Fission is only observed in rather peripheral collisions and represents approximately 20% of the total reaction cross-section. The fission process occurs after collisions in which up to 550 MeV have been dissipated. The angular and energy distribution of the fragments can be accounted for by assuming a noticeable spin alignment of the fissioning nuclei. (author) 18 refs.; 3 figs.

27844 (GANIL-P–92-18) **Nuclear fission with a Langevin equation.** Boilley, D. (Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France)); Suraud, E.; Abe, Yasuhisa; Ayik, S. Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France). [1992]. [28p.] Order Number DE93631897. Source: OSTI; NTIS (US Sales Only); INIS.

A microscopically derived Langevin equation is applied to thermally induced nuclear fission. An important memory effect is pointed out and discussed. A strong friction coefficient, estimated

from microscopic quantities, tends to decrease the stationary limit of the fission rate and to increase the transient time. The calculations are performed with a collective mass depending on the collective variable and with a constant mass. Fission rates calculated at different temperatures are shown and compared with previous available results. (author) 23 refs.; 7 figs.

27845 (GANIL-P–92-20) **Elastic scattering of a secondary ^{11}Li beam on ^{28}Si at 29 MeV/n.** Lewitowicz, M. (Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France)); Borcea, C.; Carstoiu, F.; Bimbot, R.; Borrel, V.; Dogny, S.; Gareev, F.A.; Ershov, S.N.; Dlouhy, Z.; Nosek, L. Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France). [1992]. [21p.] Order Number DE93631885. Source: OSTI; NTIS (US Sales Only); INIS.

The elastic scattering of a secondary ^{11}Li beam (29 MeV/n) on a ^{28}Si target has been measured for the first time. To compensate for the low intensity of the secondary beam, an efficient detecting system permitting to obtain reliable experimental data has been used. An attempt has been made to reproduce the data in a phenomenological analysis and with coupled-channel calculations with a double folding optical potentials, with energy and density dependent effective interaction and realistic densities. In coupled-channel calculations with the folding optical potential a better description is achieved if a neutron halo of ^{11}Li is taken into account. (author) 30 refs.; 7 figs.; 4 tabs.

27846 (GANIL-P–92-23) **Emission of complex fragments in the reaction Ar+Au at 44 and 77 A.MeV.** Sokolov, A. (Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France)); Guerreau, D.; Jiang, D.X.; Charvet, J.L.; Frehaut, J.; Cramer, B.; Ingold, G.; Gatty, B. Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France). 1992. [44p.] Order Number DE93631886. Source: OSTI; NTIS (US Sales Only); INIS.

Complex fragment emission from the 44 and 77 A.MeV ^{40}Ar + ^{197}Au reaction was investigated, and complex fragments have been detected, together with the associated neutron multiplicity distributions, and are seen to be preferentially emitted in violent collisions. Equilibrium and non-equilibrium components were identified which are discussed in terms of statistical emission from the hot target-like fragment and of a possible persistence of a deep-inelastic process. (R.P.) 45 refs.; 16 figs.; 1 tab.

27847 (ISN–92-102) **Reaction ^{40}Ca+^{nat}Cu at 35 MeV/nucleon measured with the AMPHORA multidetector. Study of the excitation energy and angular momentum of the reconstructed projectile-like fragment.** Elhage, H. Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires. Oct 1992. [102p.] (In French). Order Number DE93631887. Source: OSTI; NTIS (US Sales Only); INIS.

We have studied the reaction of ^{40}Ca with ^{nat}Cu at 35 MeV/nucleon with the AMPHORA multidetector. Three different reaction models were developed and we have shown that a simulation of the AMPHORA response is necessary to interpret the experimental results. Only two-body events were analyzed. Kinematic selection criterions, based on relative velocity, were used in order to isolate particles and residues coming from the de-excitation of the projectile-like fragment. The reconstitution of such a nucleus allowed to define the reaction plane and to calculate the energy balance event-by-event. We have proposed a method to determine the angular momentum based on the emission asymmetry of the light particles with respect to the normal to the reaction plane. The estimated angular momenta are in good agreement with the theoretical predictions. The projectile-like fragment temperature was estimated from the energy spectra of the light particles. The independent determination of the excitation energy, temperature and angular momentum allowed to calculate the level density parameter. This quantity does not evolve with the excitation energy and is equal to A/8. The projectile-like fragment de-excitation mode is mainly evaporation.

27848 (JAERI-M–92-202) **Report of the joint seminar on solid state physics, atomic and molecular physics, and materials science in the energy region of tandem accelerators.** Kazumata, Yukio (ed.) (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment). Japan Atomic Energy Research Inst., Tokyo (Japan). Jan 1993. 103p. (In Japanese, English). (CONF-9101168–: Joint seminar on solid state physics, atomic and molecular physics, and material science in the energy region of tandem accelerators, Tokai (Japan), 22-23 Jan 1991). Order Number DE93508268. Source: OSTI; NTIS; INIS.

The joint seminar on Solid State Physics, Atomic and Molecular Physics and Materials Science in the Energy Region of Tandem Acceleration was held at Tokai Research Establishment of JAERI, for two days from January 22 to 23, 1991. About 60 physicists and material scientists participated and 18 papers were presented in this seminar. The topics presented in this seminar included lattice defects in semiconductors, ion-solid collisions, atomic collisions by high energy particles, radiation effects on high T_c superconducting materials and FCC metals, radiation effects on materials of space and fusion reactors, uranium compounds and superlattice. (J.P.N.).

27849 (JAERI-M–93-020) **Neutron-photon multigroup cross sections for neutron energies up to 400 MeV: HILO86R: Revision of HILO86 library.** Kotegawa, Hiroshi (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment); Nakane, Yoshihiro; Hasegawa, Akira; Tanaka, Shun-ichi. Japan Atomic Energy Research Inst., Tokyo (Japan). Feb 1993. 32p. Order Number DE93508285. Source: OSTI; NTIS; INIS.

A macroscopic multigroup cross section library of 66 neutron and 22 photon groups for neutron energies up to 400 MeV: HILO86R is prepared for 10 typical shielding materials; water, concrete, iron, air, graphite, polyethylene, heavy concrete, lead, aluminum and soil. The library is a revision of the DLC-119/HILO86, in which only the cross sections below 19.6 MeV have been exchanged with a group cross section processed from the JENDL-3 microscopic cross section library. In the HILO86R library, self shielding factors are used to produce effective cross sections for neutrons less than 19.6 MeV considering rather coarse energy meshes. Energy spectra and dose attenuation in water, concrete and iron have been compared among the HILO, HILO86 and HILO86R libraries for different energy neutron sources. Significant discrepancy has been observed in the energy spectra less than a couple of MeV energy in iron among the libraries, resulting large difference in the dose attenuation. The difference was attributed to the effect of self-shielding factor, namely to the difference between infinite dilution and effective cross sections. Even for 400 MeV neutron source the influence of the self-shielding factor is significant, nevertheless only the cross sections below 19.6 MeV are exchanged. (author).

27850 (JAERI-M–93-050) **Installation of Monte Carlo neutron and photon transport code system MCNP4: Improvements of graphic functions and cross section library for Sun work stations.** Takano, Makoto (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment); Sasaki, Mikio; Kaneko, Toshiyuki; Yamazaki, Takao. Japan Atomic Energy Research Inst., Tokyo (Japan). Mar 1993. 78p. (In Japanese). Order Number DE93508321. Source: OSTI; NTIS; INIS.

The continuous energy Monte Carlo code MCNP-4 including its graphic functions has been installed on the Sun-4 sparc-2 work station with minor corrections. In order to validate the installed MCNP-4 code, 25 sample problems have been executed on the work station and these results have been compared with the original ones. And, the most of the graphic functions have been demonstrated by using 3 sample problems. Further, additional 14 nuclides have been included to the continuous cross section library edited from JENDL-3. (author).

27851 (JINR-E–1-91-496) **The differential cross sections for inclusive reactions π^++A→η+X at 10 GeV.** Budagov, Yu.A. (and others); Chirikov-Zorin, I.E.; Dzhelepov, V.P. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Nuclear Problems. 1991. [16p.] Order Number DE93630050. Source: OSTI; NTIS (US Sales Only); INIS.

Submitted to Nucl. Phys., B.

The differential cross sections are presented for inclusive reactions π^++A→η+X on H, D, Li, Be, Al, Cu nuclei at the energy of 10.5 GeV in the beam fragmentation region. The fragmentation process $\pi \rightarrow \eta$ is described within the framework of the string model which allows for colour transparency of nuclei and effects of final-state formation length. Taking into account the QCD-predicted dependence of the interaction cross section on the quark structure

of hadrons one can qualitatively describe this process for a large group of target nuclei. 15 refs.; 11 figs.; 3 tabs.

27852 (JINR-E-2-91-562) **On anomalous ^{24}Na production in high-energy nuclear interactions.** Polanski, A.; Sosnin, A.N.; Toneev, V.D. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Computing Techniques and Automation. 1991. [14p.] Order Number DE93630045. Source: OSTI; NTIS (US Sales Only); INIS.

Submitted to At. Ehnerg.

Recent experiments on anomalously high production of ^{24}Na fragments at large angles in high-energy C-Cu interactions are analysed starting from a cascade-evaporation model (CEM) and taking into consideration effects of particle transport through a matter. It turned out that no unusual mechanism of nucleus-nucleus collisions is needed to explain the experimental results. 14 refs.; 4 figs.; 5 tabs.

27853 (JINR-R-1-92-45) **The transverse cross section in ^{16}Op interactions at 3.1 AxGev/c and isotope composition of two-charge fragments.** Botvina, A.S. (AN SSSR, Moscow (Russian Federation). Inst. Yadernykh Issledovanij); Buzdavina, N.A.; Wislicki, W. Joint Inst. for Nuclear Research, Dubna (Russian Federation). 1992. [7p.] (In Russian). Order Number DE93630039. Source: OSTI; NTIS (US Sales Only); INIS.

The experimental data for the transverse cross section, multiplicity and relative yield of two-charge fragments of the oxygen nucleus (^{3}He$_2$ and ^{4}He$_2$ nuclei), produced in ^{16}Op-interactions at momentum 3.1 AxGeV/c are presented. The data are compared with the results made in the frame of the cascade-fragmentation-evaporation model of proton-nucleus interactions. 7 refs.; 5 figs.

27854 (JINR-R-3-92-230) **About anomalous scattering of p neutrons by tellurium nuclei.** Mitsyna, L.V.; Samosvat, G.S. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Neutron Physics. 1992. [8p.] (In Russian). Order Number DE93630040. Source: OSTI; NTIS (US Sales Only); INIS.

Submitted to Yad. Fiz.

The neutron strength functions and scattering radii R'_0 and R'_1 for s- and p-waves were calculated from differential neutron scattering cross sections of ^{128}Te and ^{130}Te isotopes measured at up to ≈300 keV neutron energies for three different angles. As for earlier investigated natural isotope mixture of Te the radii of p scattering are essentially less than for neighbouring nuclei, while average R' for the rest isotopes of Te is, apparently, 'normal'. The possibility is demonstrated to explain this anomaly through doorway states being formed in ^{129}Te and ^{131}Te compound nuclei with spins and parities $1/2^-$ and (or) $3/2^-$. 5 refs.; 5 figs.; 1 tab.

27855 (JINR-R-3-92-245) **Analysis of the nonstatistical behaviour of the radiative strength function at capture of thermal and resonance neutron.** Vasil'eva, Eh.V.; Vojnov, A.V.; Kulik, V.D.; Popov, Yu.P.; Sukhovoj, A.M.; Khitrov, V.A.; Khol'nov, Yu.V.; Shilin, V.N. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Neutron Physics. 1992. [15p.] (In Russian). Order Number DE93630041. Source: OSTI; NTIS (US Sales Only); INIS.

Submitted to Yad. Fiz.

In this work a method is suggested of a search for nonstatistical regularities in behaviour of radiative strength fucntion of primary γ-transitions from the (n, γ) reaction. The correlation analysis of the primary γ-transition intensities for the ^{174}Yb, ^{168}Er, ^{178}Hf nuclei has been carried out on the basis of the data from thermal and 2 keV neutron capture experiments. The positive values obtained for the correlation coefficient in the case of ^{174}Yb and ^{168}Er allow the conclusion to be made, at a high level of confidence, about the presence of considerable deviations of the radiative strength function from mean statistical value. 20 refs.; 6 figs.; 1 tab.

27856 (LA–12560-T) **Reaction mechanism and nuclear correlations study by low energy pion double charge exchange.** Weinfeld, Z. Los Alamos National Lab., NM (United States). Jun 1993. 143p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93015863. Source: OSTI; NTIS; INIS; GPO Dep.

Thesis submitted to Tel Aviv Univ. (IL).

In pion double-charge-exchange (DCX) reactions, a positive (negative) pion is incident on a nucleus and a negative (positive) pion emerges. These reactions are of fundamental interest since the process must involve at least two nucleons in order to conserve charge. Although two nucleon processes are present in many reactions they are usually masked by the dominant single nucleon processes. DCX is unique in that respect since it is a two nucleon process in lowest order and thus may be sensitive to two-nucleon correlations. Measurements of low energy pion double-charge-exchange reactions to the double-isobaric-analog-state (DIAS) and ground-state (GS) of the residual nucleus provide new means for studying nucleon-nucleon correlations in nuclei. At low energies (T_π <65 MeV) the πN interaction is relatively weak thus simplifying the theoretical treatment of the problem. Also, isobaric-analog-state (IAS) transitions are suppressed near 50 MeV due to destructive s-p wave interference in the πN scattering amplitude leading to enhancement of DIAS transitions through non-analog intermediate states. Theoretical studies by several groups have shown that, while transitions through the analog route involve relatively large nucleon-nucleon distances, those through the non-analog intermediate states involve distances of the order 1 to 2 fm. Therefore, DCX reactions at low incident pion energies provide a way to study the short-range part of the nucleon-nucleon correlations. The author presents measured DCX cross sections of DIAS and GS transitions for several nuclei in the $f_{7/2}$ shell at energies ranging from 25 to 65 MeV. Cross sections were measured on ^{42,44,48}Ca, ^{46,50}Ti and ^{54}Fe. The calcium isotopes make a good set of nuclei on which to study the effects of correlations in DCX reactions.

27857 (LA-UR–93-1692) **Dynamics of pion-nucleus systems.** Johnson, M.B. Los Alamos National Lab., NM (United States). [1993]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930389–13: Future directions in particle and nuclear physics at multi-GeV hadron beam facilities, Upton, NY (United States), 4-6 Mar 1993). Order Number DE93014449. Source: OSTI; NTIS; INIS; GPO Dep.

The prospects for using high-energy pions to examine modifications of baryon resonances in nuclei, nuclear structure, exchange currents, short-range correlations, and to characterize pion propagation are discussed.

27858 (LBL–34008) **Complex fragment production and multifragmentation in 60 MeV/u ^{129}Xe-induced reactions.** Wozniak, G.J.; Skulski, W.; Tso, K.; Colonna, N.; Moretto, L.G. Lawrence Berkeley Lab., CA (United States). Apr 1993. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-930197–4: 9. winter workshop on nuclear dynamics, Key West, FL (United States), 30 Jan - 6 feb 1993). Order Number DE93015176. Source: OSTI; NTIS; INIS; GPO Dep.

Complex fragment production has been studied in nearly 4π geometry for the 60 MeV/u ^{129}Xe + ^{27}Al, ^{nat}Cu, ^{89}Y, ^{165}Ho and ^{197}Au reactions. The total number of light charged particles and complex fragments increases strongly with the mass of the target, reaching values of 40 for the ^{197}Au target. The yield of intermediate mass fragments reaches values greater than 10 for central collisions on ^{197}Au. For a subset of the events, 80% of the total charge in the reaction channel is detected.

27859 (LPCC–92-02) **Excitation energy distributions in fusion reactions induced by Ar projectiles at 50 and 70 MeV/u.** Vient, E. (Caen Univ., 14 (France). Lab. de Physique Corpusculaire); Badala, A.; Barbera, R.; Bizard, G.; Bougault, R.; Brou, R.; Cussol, D.; Colin, J.; Durand, D.; Drouet, A.; Horn, D.; Laville, J.L.; Le Brun, C.; Lecolley, J.F.; Leflecher, C.; Louvel, M.Caen Univ., 14 (France). Lab. de Physique Corpusculaire. 1992. [12p.] (CONF-920140–: 30. winter meeting on nuclear physics, Bormio (Italy), 27 Jan - 1 feb 1992). Order Number DE93631889. Source: OSTI; NTIS (US Sales Only); INIS.

In the present experiment, we have studied the Ar+Ag system at two bombarding energies: 50 and 70 MeV/u. We have first focused on the standard decay of the corresponding hot nuclei, i.e. on the formation of evaporated residues, which have been detected in coincidence with most of the decay charged particles (use of a 4 π device). From this very complete knowledge of the events, it has been possible to determine the excitation energy distribution of the

initial hot nuclei. In a second step of the analysis, we have extended the triggering conditions to more complicated events including multi-fragment emission. In section 2 of this paper, we describe the experimental set up. Section 3 is devoted to the results involving an evaporation residue. Section 4 is devoted to triggering conditions based on the multiplicity detected in the 4 π device. Section 5 is a summary of the results.

27860 (LPCC–92-03) **Inversion of collective matter flow and equation of state.** Peter, J. Caen Univ., 14 (France). Lab. de Physique Corpusculaire. Mar 1992. [13p.] (CONF-920318–: International workshop on dynamical fluctuations and correlations in nuclear collisions, Aussois (France), 12-20 Mar 1992). Order Number DE93631890. Source: OSTI; NTIS (US Sales Only); INIS.

The multidetector array Mur + Tonneau has been used to perform a 4π detection of charged particles and fragments emitted in reactions at energies ranging from 25 to 95 MeV/u. The collective transverse momentum in the reaction plane (sidewards flow parameter) is observed to strongly vary as a function of impact parameter and incident energy. The measured values have to be corrected for the effects due to the error on the reaction plane determination and to the detector limitations. Those limitations caused by the method itself are more important than those caused by the detector. The flow value changes from negative values (negative scattering at low energies). The inversion (or balance) energy is in the range 50-100 MeV/u, depending on the system and impact parameter value. Comparisons between experimental data and theoretical values are shown for the system ^{40} Ar + ^{27} Al. These studies (BUU, Landau-Vlasov, QMD) show that the flow, and especially the inversion energy, is sensitive to the nucleon-nucleon cross section σNN in medium. The data indicate that a momentum dependent effective interaction should be used. Then, the flow value is not much sensitive to the incompressibility modulus K, but possibly in peripheral collisions. Additional observables should be used. The azimuthal distribution of mid-rapidity particles indicates a rotation-like behaviour of the interaction region.

27861 (LPCC–92-04) **Charged particle calorimetry of ^{40}Ar + ^{27}Al reactions from 36 to 65 MeV/u.** Cussol, D. (Caen Univ., 14 (France). Lab. de Physique Corpusculaire); Bizard, G.; Brou, R.; Durand, D.; Louvel, M.; Patry, J.P.; Peter, J.; Sullivan, J.P.; Regimbart, R.; Steckmeyer, J.C.; Tamain, B.; Doubre, H.; Peghaire, A.; Saint-Laurent, F.; Crema, E. Caen Univ., 14 (France). Lab. de Physique Corpusculaire; Caen Univ., 14 (France). Apr 1992. [27p.] Order Number DE93631891. Source: OSTI; NTIS (US Sales Only); INIS.

Temperatures and excitation energies have been independently measured for hot nuclei formed in the Ar on Al reactions from 36 to 65 MeV/u. Charged products have been measured in a geometry close to 4 π in the center of mass with multidetectors MUR and TONNEAU. The events have been sorted as a function of the impact parameter value. The products emitted from the equilibrated incomplete fusion nuclei are separated from the nucleons and clusters emitted in the first step of the collision (pre-equilibrium) and from the target-like nuclei. The qualitative variation of temperature and excitation energy values have been deduced from the charge distribution of residual nuclei and the transverse energy. Quantitative values are obtained from the kinetic energy distributions of particles in the frame of the reconstructed equilibrated nucleus. At each incident energy, the temperature and excitation energy are both increasing when the impact parameter value decreases. For central collisions (b<2fm), the temperature increases with the incident energy, slowly above 45 MeV/u, and reaches a value of 7 MeV. The excitation energy per nucleon increases similarly. The correlation between the excitation energy per nucleon and the temperature shows an evolution of the level density parameter value.

27862 (LPCC–92-05) **High transverse momentum events in Kr+Au, Th central collisions at 43 MeV/u.** Bougault, R. (Caen Univ., 14 (France). Lab. de Physique Corpusculaire); Colin, J.; Delaunay, F.; Genoux-Lubain, A.; Le Brun, C.; Lecolley, J.F.; Lefebvres, F.; Louvel, M.; Steckmeyer, J.C.; Adloff, J.C.; Bilwes, B.; Bilwes, R.; Glaser, M.; Rudolf, G.; ScheCaen Univ., 14 (France). Lab. de Physique Corpusculaire. May 1992. [29p.] Order Number DE93631892. Source: OSTI; NTIS (US Sales Only); INIS.

The multi-fragment production of the systems Kr+(Ag,Au,Th) is studied at 43 A.MeV. Heavy fragments ($Z \geq 6$) were identified in coincidence by 4 π arrangement of low threshold detectors. Up to six fragments have been detected per event. An analysis based on relative velocities between the detected fragments allowed us to separate peripheral reactions from central collisions. For the central events large transverse energy values, clue for dynamical effects, are observed for Au- and Th-system.

27863 (LPCC-T–92-02) **Study of Krypton-Silver, Krypton-gold, Krypton-thorium interactions at 27 and 43 MeV/n in terms of global variables.** Lemiere, J. Caen Univ., 14 (France). Lab. de Physique Corpusculaire. Jul 1992. [132p.] (In French). Order Number DE93631888. Source: OSTI; NTIS (US Sales Only); INIS.

The determination of desexcitation mechanism of hot and compressed nuclear systems formed after heavy ions collisions at intermediate energies asks for and exclusive and complete detection of the products of the reaction and so the use of multidetectors with large angular coverage. In this work, we study fragment production (Z>8) in nuclear collisions of krypton projectiles accelerated at 27 MeV/uma and 43 MeV/uma with silver, gold and thorium target with the help of the measurements provided by two gaseous multidetectors DELF and XYZT at GANIL. We observed events with a multiplicity of fragments up to 5 and 6 at 27 and 43 MeV/uma respectively (whatever the nature of target). We restricted our study to central collisions with at least 3 heavy fragments detected by separating peripheral collisions which had kept the memory of entrance channel. The recoil velocity of fragments for central events indicates high excitation energy which is comparable to total binding energy of the system. In order to normalize and compact the information which represent the velocities and charges of the 3, 4 or 5 detected fragments, we used several global variables as flow angle and isotropy ratio. We tested if these variables were no too modified by the limitations of the experimental setup by using Monte Carlo simulations. We observed some important differences between the systems we used: first, more events with large flow angle or isotropy ratio for the gold target than for the silver one, second relatively more events with large isotropy ratio for 43 MeV/uma than for 27 MeV/uma. Events with small flow angle has a weak memory of the entrance channel, but the events with large flow angle do not, this indicates the flow angle to be an estimation of impact parameter. The difference between gold and silver target has been assumed to be due to the difference of overlap cross section of the Kr-Au and Kr-Ag systems.

6635 Nuclear Mass Ranges

Refer also to citation(s) 27178, 27813, 27814, 27823, 27825, 27836, 27837, 27839, 27840, 27841, 27843, 27845, 27846, 27847, 27849, 27852, 27853, 27854, 27855, 27856, 27857, 27858, 27859, 27860, 27861, 27862, 27863, 27864

6636 Radiation Physics

Refer also to citation(s) 26202, 26899, 26900, 27631, 28150, 28151

27864 (CEA-N–2709) **Calculations of neutron cross sections for ^{178}Hf^{m2} in the energy range 10 KeV-3 MeV and for thermal neutrons.** Lagrange, C. CEA Centre d'Etudes de Bruyeres-le-Chatel, 91 (France). Jan 1993. [22p.] (In French). Order Number DE93631898. Source: OSTI; NTIS (US Sales Only); INIS.

We present coherent optical and statistical model calculations of neutron interactions with the second isomeric state of ^{178} Hf (16$^+$) at incident energies between 10 keV and 3 MeV. As this isomeric state lie in the continuum region the level density parameters of the back-shifted Fermi gas model are employed in the statistical model calculations. The uncertainties of the theoretical calculations arise mainly from the determination of the level density spin distribution for ^{178} Hf. The optical and statistical model parameters are then extrapolated to the calculations of inelastic acceleration of thermal neutrons by ^{178} Hf^{m2} and ^{180} Hf^{m1}. New measurements are suggested to assess the validity of our predictions.

27865 (CONF-9205173–1-Vugraphs) **General order characteristic methods for solving neutron transport problems.** Azmy,

Y.Y. Oak Ridge National Lab., TN (United States). [1992]. 27p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From International symposium on transport theory; Moscow (Russian Federation); 23-31 May 1992. Order Number DE93015824. Source: OSTI; NTIS; INIS; GPO Dep.

The neutron transport equation in Cartesian geometry possesses straight line characteristics along which the streaming operator can be written as a full differential in terms of the characteristic length. This idea was used by Lathrop to develop the step characteristic method, which he showed to be positive definite but less accurate than conventional Diamond-Difference schemes. Several authors since then have developed new methods utilizing the characteristic curves (including non-Cartesian geometry). A Linear Characteristic Method, based on a more consistent linear representation of the incoming-surface and within-cell angular flux, has been developed and tested in two-dimensional geometry producing highly accurate and computationally efficient results. A similar linear method, with several modifications, was developed for three-dimensional Cartesian geometry, and implemented in ORNL's production code TORT. In this paper is presented a fully consistent, two-dimensional Cartesian geometry, general order characteristic method, in the same spirit as the previously developed, general order nodal method. Preliminary tests and numerical error analysis of the new method for orders up to five are also presented.

27866 (CONF-9304131–7) **Development and application of the automated Monte Carlo biasing procedure in SAS4.** Tang, J.S.; Broadhead, B.L. Oak Ridge National Lab., TN (United States). [1993]. 21p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Advanced Monte Carlo computer programs for radiation transport; Saclay (France); 27-29 Apr 1993. Order Number DE93015205. Source: OSTI; NTIS; INIS; GPO Dep.

An automated approach for biasing Monte Carlo shielding calculations is described. In particular, adjoint fluxes from a one-dimensional discrete-ordinates calculation are used to generate biasing parameters for a three-dimensional Monte Carlo calculation. The automated procedure consisting of cross-section processing, adjoint flux determination, biasing parameter generation, and the initiation of a MORSE-SGC/S Monte Carlo calculation has been implemented in the SAS4 module of the SCALE computer code system. The automated procedure has been used extensively in the investigation of both computational and experimental benchmarks for the NEACRP working group on shielding assessment of transportation packages. The results of these studies indicate that with the automated biasing procedure, Monte Carlo shielding calculations of spent fuel casks can be easily performed with minimum effort and that accurate results can be obtained at reasonable computing cost. The systematic biasing approach described in this paper can also be applied to other similar shielding problems.

27867 (DOE/ER/45415–9) **Many-body corrections in XAFS.** Rehr, J.J. Washington Univ., Seattle, WA (United States). Dept. of Physics. [1992]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG06-90ER45415. (CONF-9208221–2: International workshop on surface x-ray absorption fine structure (XAFS), Jaipur (India), Aug 1992). Order Number DE93011002. Source: OSTI; NTIS; INIS; GPO Dep.

The importance of many-body effects in the theory of XAFS is reviewed. The dominant effects are inelastic losses: Extrinsic losses refer to inelastic losses in the propagation of the photoelectron and are treated using a complex, energy-dependent self-energy. The real part of the self-energy yields an important energy-dependent shift in the phase of the XAFS oscillations, while the imaginary part contributes to the mean-free-path. Intrinsic losses refer to losses associated with the creation of the core-hole. They give rise to shake-up/shake-off contributions to the absorption spectra. These losses may be calculated in terms of a corehole Green's function. Interference between these processes leads to dynamical corrections, which are important at low energies.

27868 (IYaF–91-115) **Solution of the problem of mean energy electron passage through matter.** Arzhannikov, A.V.; Sinitskij, S.L.; Yalovets, A.P. AN SSSR, Novosibirsk (Russian Federation). Inst. Yadernoj Fiziki. 1991. [34p.] (In Russian). Order Number DE93630061. Source: OSTI; NTIS (US Sales Only); INIS.

Methods of computerized solution of the problem of 10-100 keV energy electron passage through matter are developed. This may form the basis of theoretical description of rather complex physical phenomena involving participation of such electrons. Validity of accepted approach to solution of the problem and correctness of used physical formulas and numerical factors are verified by comparison of test calculations with experimental results described in publications. 35 refs.; 6 figs.

27869 (JAERI-M–93-024) **Installation and execution of criticality and radiation shielding analysis codes on engineering work station.** Masukawa, Fumihiro (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment); Takano, Makoto; Inoue, Osamu; Hara, Toshiharu. Japan Atomic Energy Research Inst., Tokyo (Japan). Feb 1993. 36p. (In Japanese). Order Number DE93508312. Source: OSTI; NTIS; INIS.

Nowadays, the performance of the engineering work stations (EWS) shows remarkable progress. Its computing speed bears comparison with that of large scale computer, so it is possible to run critical and radiation shielding analysis codes with reasonably acceptable time. Thus, installation and demonstration of the running time of critical and radiation shielding analysis codes dose not only make parametric case studies easy, but also might facilitate the installation of the same scale codes to EWS on other fields, and therefore might relief loads of large scale computers. On this work, critical and radiation shielding analysis codes such as MAIL3, ANISN, TWOTRAN, KENO-IV, CITATION, VIM, DORT, and ORIGEN2, which are often used to by our studies, were converted to install and executed on EWS SUN-4/2. At the same time, the submit command was made to enable arbitrary specification of I/O access files. (author).

27870 (JINR-E–13-92-316) **Proposal of a wide-band mirror polarizer of slow neutrons at a pulsed neutron source.** Nikitenko, Yu.V.; Ostanevich, Yu.M. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Neutron Physics. 1992. [10p.] Order Number DE93630059. Source: OSTI; NTIS (US Sales Only); INIS.

Submitted to Nucl. Instrum. Methods.

The new type wide-band mirror-based neutron polarizer to be operated at a pulsed neutron source is suggested. The idea is to use a movable polarizing mirror system, which, be the incoming beam monochromatized by the time-of-flight, would allow one to tune glancing angles in time so, that the total reflection condition is always fulfilled only for one of the two neutron spin eigenstates. Estimates show, that with the pulsed reactor IBR-2 such polarizer allows one to build a small-angle neutron scattering instrument capable to effectively use the wave-length band from 2 to 15 A. 9 refs.; 1 fig.

27871 (LA-UR–93-1216) **The LAHET code system: Introduction, development, and benchmarking.** Prael, R.E. Los Alamos National Lab., NM (United States). [1993]. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930168–6: Simulating accelerator radiation environments workshop, Santa Fe, NM (United States), 11-15 Jan 1993). Order Number DE93012657. Source: OSTI; NTIS; GPO Dep.

An introduction to the LAHET code system is presented, showing the function of each code and their interrelation. A summary is made of the principal physics models used in LAHET. Some recent results in benchmarking axe shown for small-angle neutron emission from ^{7}Li for 800 MeV protons incident, neutron emission from ^{9}Be at several incident proton energies, and actinide and subactinide fission ratios.

27872 (LA-UR–93-1446) **A new method to assess Monte Carlo convergence.** Forster, R.A.; Booth, T.E.; Pederson, S.P. Los Alamos National Lab., NM (United States). [1993]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9304131–3: Advanced Monte Carlo computer programs for radiation transport, Saclay (France), 27-29 Apr 1993). Order Number DE93012667. Source: OSTI; NTIS; GPO Dep.

The central limit theorem can be applied to a Monte Carlo solution if the following two requirements are satisfied: (1) the random

variable has a finite mean and a finite variance; and (2) the number N of independent observations grows large. When these are satisfied, a confidence interval based on the normal distribution with a specified coverage probability can be formed. The first requirement is generally satisfied by the knowledge of the type of Monte Carlo tally being used. The Monte Carlo practitioner has only a limited number of marginally quantifiable methods that use sampled values to assess the fulfillment of the second requirement; e.g., statistical error reduction proportional to $1/\sqrt{N}$ with error magnitude guidelines. No consideration is given to what has not yet been sampled. A new method is presented here to assess the convergence of Monte Carlo solutions by analyzing the shape of the empirical probability density function (PDF) of history scores, f(x), where the random variable x is the score from one particle history and $\int_{-\infty}^{\infty} f(x)\,dx = 1$. Since f(x) is seldom known explicitly, Monte Carlo particle random walks sample f(x) implicitly. Unless there is a largest possible history score, the empirical f(x) must eventually decrease more steeply than $1/x^3$ for the second moment ($\int_{-\infty}^{\infty} x^2 f(x)\,dx$) to exist.

27873 (LA-UR–93-1475) **MCNP4A: Features and philosophy.** Hendricks, J.S. Los Alamos National Lab., NM (United States). [1993]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9304137–1: Centre d'Etudes meeting, Saclay (France), 27-29 Apr 1993). Order Number DE93012749. Source: OSTI; NTIS; INIS; GPO Dep.

This paper describes MCNP, states its philosophy, introduces a number of new features becoming available with version MCNP4A, and answers a number of questions asked by participants in the workshop. MCNP is a general-purpose three-dimensional neutron, photon and electron transport code. Its philosophy is "Quality, Value and New Features." Quality is exemplified by new software quality assurance practices and a program of benchmarking against experiments. Value includes a strong emphasis on documentation and code portability. New features are the third priority. MCNP4A is now available at Los Alamos. New features in MCNP4A include enhanced statistical analysis, distributed processor multitasking, new photon libraries, ENDF/B-VI capabilities, X-Windows graphics, dynamic memory allocation, expanded criticality output, periodic boundaries, plotting of particle tracks via SABRINA, and many other improvements. 23 refs.

27874 (LA-UR–93-1922) **Application of a simple analytical model to estimate effectiveness of radiation shielding for neutrons.** Frankle, S.C.; Fitzgerald, D.H.; Hutson, R.L.; Macek, R.J.; Wilkinson, C.A. Los Alamos National Lab., NM (United States). [1993]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930511–52: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014456. Source: OSTI; NTIS; INIS; GPO Dep.

Neutron dose equivalent rates have been measured for 800-MeV proton beam spills at the Los Alamos Meson Physics Facility. Neutron detectors were used to measure the neutron dose levels at a number of locations for each beam-spill test, and neutron energy spectra were measured for several beam-spill tests. Estimates of expected levels for various detector locations were made using a simple analytical model developed for 800-MeV proton beam spills. A comparison of measurements and model estimates indicates that the model is reasonably accurate in estimating the neutron dose equivalent rate for simple shielding geometries. The model fails for more complicated shielding geometries, where indirect contributions to the dose equivalent rate can dominate.

27875 (LA-UR–93-1925) **Monte Carlo based formula for radiation shielding assessment in the forward direction.** Wilkinson, C.A.; Fitzgerald, D.H.; Frankle, S.C.; Hutson, R.L.; Macek, R.J. Los Alamos National Lab., NM (United States). [1993]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930511–50: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014454. Source: OSTI; NTIS; INIS; GPO Dep.

Monte Carlo simulations of 800-MeV proton beam spills in common shielding materials show that neutron dose equivalent rates in the forward direction can be characterized by a Moyer Model-like formula. Particle transport codes were used to determine the neutron flux at depths up to 6 meters and for production angles from 0° to 30° for primary proton beam spills on cylindrical beam stops. The flux was then converted to dose equivalent rate as a function of depth and angle. The results for three common shielding materials were combined and the resulting fitted formula provides a quick method for estimating the dose equivalent rates and shielding effectiveness outside thick shielding at forward angles.

27876 (LBL–33429) **EGS_Windows2: An enhanced graphical interface to EGS.** Chatterjee, S. (California Univ., Berkeley, CA (United States). Dept. of Electrical Engineering and Computer Science); Donahue, R.J. Lawrence Berkeley Lab., CA (United States). 7 Jan 1993. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-9302113–1: International conference on Monte Carlo simulation in nuclear and high energy physics, Tallahassee, FL (United States), 22-26 Feb 1993). Order Number DE93010447. Source: OSTI; NTIS; GPO Dep.

This report gives a general overview of the EGS_Windows2 program. The program is intended to be used to display individual particle histories of electrons, photons, and positrons generated by the EGS4 Code System. Much of this work is based on the earlier version of EGS_Windows2 from the Institute for National Measurement Standards at the National Research Council of Canada (NRCC). No attempt is made to modify their EGS subroutine WATCH, which is used to output the particle vectors to be read by EGS-Windows, or duplicate any of the documentation describing the subroutine. EGS_Windows2 reads data in the same format as produced by WATCH. Users of EGS_Windows2 are encouraged to obtain the original EGS_Windows report from the NRCC in addition to this report as complete documentation of EGS_Windows2. As in the original report, two levels of information are covered in this report: the user level, and the programmer level. The user level should be read by all users. It describes execution, operation, and capabilities. The programmer level should be read by those users who may want to modify the program or who would like a more detailed understanding. It describes briefly the routines and there function, as well as the major changes in the new release of the 3D graphics programming library Sun PHIGS 2.0.

27877 (SAND–93-0482C) **Variance reduction unique to coupled electron/photon Monte Carlo transport.** Halbleib, J.A.; Kensek, R.P.; Valdez, G.D. Sandia National Labs., Albuquerque, NM (United States). [1993]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9304131–5: Advanced Monte Carlo computer programs for radiation transport, Saclay (France), 27-29 Apr 1993). Order Number DE93014999. Source: OSTI; NTIS; INIS; GPO Dep.

The disparity between the mean free paths of electrons and photons leads to unique variance-reduction procedures for the coupled transport at intermediate energies. It is electrons that ultimately deposit charge and energy, yet electron transport is much more expensive than photon transport. The objective, then, is to control the variance of the energy, angular, and spatially dependent populations of the two species within the generation and transport of the cascade in such a way that all contributions to electron flux in the vicinity of the detector are represented to a degree commensurate with their importance. However, in β/γ transport, biasing techniques are often unique to one or the other of the species.

27878 (SAND–93-1010C) **ITS Version 3.0: The Integrated TIGER Series of coupled electron/photon Monte Carlo transport codes.** Halbleib, J.A. (Sandia National Labs., Albuquerque, NM (United States)); Kensek, R.P.; Valdez, G.D.; Mehlhorn, T.A.; Seltzer, S.M.; Berger, M.J. Sandia National Labs., Albuquerque, NM (United States). [1993]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9304131–6: Advanced Monte Carlo computer programs for radiation transport, Saclay (France), 27-29 Apr 1993). Order Number DE93015015. Source: OSTI; NTIS; INIS; GPO Dep.

ITS is a powerful and user-friendly software package permitting state-of-the-art Monte Carlo solution of linear time-independent coupled electron/photon radiation transport problems, with or without the presence of macroscopic electric and magnetic fields. It

combines operational simplicity and physical accuracy in order to provide experimentalists and theorists alike with a method for the routine but rigorous solution of sophisticated radiation transport problems. Flexibility of construction permits tailoring of the codes to specific applications and extension of code capabilities to more complex applications through simple update procedures.

6640 Atomic and Molecular Physics

27879 (PNL–8642) **Theory, modeling, and simulation annual report, 1992.** Pacific Northwest Lab., Richland, WA (United States). May 1993. 103p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93015607. Source: OSTI; NTIS; GPO Dep.

This report briefly discusses research on the following topics: development of electronic structure methods; modeling molecular processes in clusters; modeling molecular processes in solution; modeling molecular processes in separations chemistry; modeling interfacial molecular processes; modeling molecular processes in the atmosphere; methods for periodic calculations on solids; chemistry and physics of minerals; graphical user interfaces for computational chemistry codes; visualization and analysis of molecular simulations; integrated computational chemistry environment; and benchmark computations.

6641 Theory of Electronic Structure of Atoms and Molecules

Refer also to citation(s) 27905

6642 Spectra of Atoms and Molecules and Their Interactions With Photons

27880 (ANL/PHY/CP–79637) **Resonant x-ray Raman scattering from atoms and molecules.** Cowan, P.L. Argonne National Lab., IL (United States). [1992]. 34p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9208186–3: International conference on anomalous scattering (ICAS) conference, Hamburg (Germany), 17-21 Aug 1992). Order Number DE93015158. Source: OSTI; NTIS; INIS; GPO Dep.

Inelastic x-ray scattering and elastic x-ray scattering are fundamentally related processes. When the x-ray photon energy is near the ionization threshold for an inner shell, the inelastic channel is dominated by resonant x-ray Raman scattering. Studies of this emission not only illuminate the resonant scattering process in general, they also point to new opportunities for spectral studies of electronic structure using x-rays. Atoms in the form of a free gas provide an ideal target for testing the current theoretical understanding of resonant x-ray Raman scattering. In addition, x-ray scattering from molecular gases demonstrates the effect of bonding symmetry on the polarization and angular distribution of the scattered x-rays. Comparisons of experimental data with theory demonstrate both the successes and limitations of simple, single-electron interpretations of the scattering process.

27881 (CONF-9101167–1) **Towards spectroscopy of partially coherent sources.** Wolf, E. (Rochester Univ., NY (United States)). Rochester Univ., NY (United States). Dept. of Physics and Astronomy. [1991]. 22p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-90ER14119. From International conference on quantum optics; Hyderabad (India); 5-10 Jan 1991. Order Number DE93013438. Source: OSTI; NTIS; INIS; GPO Dep.

Traditional spectroscopy is concerned with spatially incoherent sources. In relatively recent times, after the invention of the lasers in 1960, spectroscopy of coherent sources has also been gradually developed. In the last few years it was found that spectroscopy of partially coherent sources i.e., those which are neither completely uncorrelated nor fully correlated, encounters certain problems. They arise from the fact predicted theoretically in 1986 and confirmed experimentally soon afterwards that, in general, the spectrum of light generated by a partially coherent source changes on propagation, even in free space. Such changes may take many different forms. For example a spectral line may be shifted or distorted or it may be split into several lines. In this talk the basic physical principles underlying this phenomenon will be described and some recent developments in this field will be reviewed.

27882 (DOE/ER/13960–5) **New infrared photon absorption processes: Final technical progress report, August 1, 1988–February 1, 1993.** Bayfield, J.E. Pittsburgh Univ., PA (United States). May 1993. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-88ER13960. Order Number DE93017017. Source: OSTI; NTIS; INIS; GPO Dep.

The fast ionization of atoms by very short laser pulses, and its possible suppression at extreme pulse intensities, is an active new field of investigation at present. Described is an investigation of whether past techniques for infrared laser multiphoton ionization of excited hydrogen atoms and of one-dimensional microwave ionization of highly excited hydrogen atoms can be combined and extended to address the new issues. Although technically difficult and requiring further improvement of apparatus, intense-field infrared laser experiments on excited hydrogen atoms are possible and can directly test theoretical and numerical results.

27883 (DOE/ER/45415–6) **Recent developments in multiple-scattering calculations of XAFS and XANES.** Rehr, J.J. Washington Univ., Seattle, WA (United States). Dept. of Physics. [1992]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG06-90ER45415. (CONF-9208160–7: 7. international conference on x-ray absorption fine structure, Kobe (Japan), 23-29 Aug 1992). Order Number DE93010999. Source: OSTI; NTIS; INIS; GPO Dep.

Curved-wave multiple-scattering (MS) theory provides a unified treatment of XAFS, encompassing both EXAFS and XANES, as well as a formal equivalence between exact treatments and the (MS) expansion carried to all orders. Recent developments in the theory of XAFS are reviewed with an emphasis on progress in curved-wave MS calculations and on understanding the nature of MS contributions in EXAFS and XANES. In particular, a unified ab initio MS treatment of XAFS is discussed based on a scattering matrix formalism which has sufficient speed and accuracy to treat high-order MS in extended systems. Neither low-order MS nor full MS theories are fully satisfactory. Instead, sufficiently high-order MS appears to be necessary for the convergence of both EXAFS and XANES calculations. The approach also gives a MS interpretation of the σ^* shape-resonances observed in XANES. It is shown that these peaks result from coherent, high-order MS. A generalization of the Natoli rule correlating the resonance locations with bond length is obtained.

27884 (UCRL-JC–112624) **High-order harmonic generation with short-pulse lasers.** Schafer, K.J.; Krause, J.L.; Kulander, K.C. Lawrence Livermore National Lab., CA (United States). Dec 1992. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-930159–43: OE/LASE '93: International Society for Optical Engineering (SPIE) conference, Los Angeles, CA (United States), 16-23 Jan 1993). Order Number DE93016532. Source: OSTI; NTIS; INIS; GPO Dep.

Recent progress in the understanding of high-order harmonic conversion from atoms and ions exposed to high-intensity, short-pulse optical lasers is reviewed. We find that ions can produce harmonics comparable in strength to those obtained from neutral atoms, and that the emission extends to much higher order. Simple scaling laws for the strength of the harmonic emission and the maximium observable harmonic are suggested. These results imply that the photoemission observed in recent experiments in helium and neon contains contributions from ions as well as neutrals.

27885 (UCRL-JC–113498) **Analysis of neon soft x-ray spectra from short-pulse laser-produced plasmas.** Abare, A.C. (Florida Univ., Gainesville, FL (United States)); Keane, C.J.; Crane, J.K.; DaSilva, L.B.; Lee, R.W.; Perry, M.D.; Falcone, R.W. Lawrence Livermore National Lab., CA (United States). Apr 1993. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-930159–36: OE/LASE '93: International Society for Optical Engineering (SPIE) conference, Los Angeles, CA (United States), 16-23 Jan 1993). Order Number DE93014420. Source: OSTI; NTIS; INIS; GPO Dep.

We report preliminary results from the analysis of streaked soft x-ray neon spectra a gas jet target. In obtained from the interaction of a picosecond Nd:glass laser with these experiments streaked spectra show prompt harmonic emission followed by longer time duration soft x-ray line emission. The majority of the line emission observed was found to originate from Li- and Be-like Ne and the major transitions in the observed spectra have been identified. Li-like emission lines were observed to decay faster in time than Be-like transitions, suggesting that recombination is taking place. Line ratios of n=4-2 and n=3-2 transitions supported the view that these lines were optically thin and thick, respectively. The time history of Li-like Ne 2p-4d and 2p-3d lines is in good agreement with a simple adiabatic expansion model coupled to a time dependent collisional-radiative code. Further x-ray spectroscopic analysis is underway which is aimed at diagnosing plasma conditions and assessing the potential of this recombining neon plasma as a quasi-steady-state recombination x-ray laser medium.

6643 Collision Phenomena

Refer also to citation(s) 26780, 26871, 27926

27886 (BNL–48218) **Stripping efficiencies for 277 MeV/amu gold beam on copper foils.** Roser, T. Brookhaven National Lab., Upton, NY (United States). [1993]. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-930511–129: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014306. Source: OSTI; NTIS; INIS; GPO Dep.

Stripping efficiencies were measured for 277 MeV/amu Au_{33+} ions with Copper foils ranging in thickness from 25μm to 100μm. The charge state distribution was analyzed using the beam line magnets of the transfer line between the AGS Booster and the AGS at Brookhaven. The relative charge state abundances were analyzed to find the optimum foil thicknesses for fully stripped Au^{79+} and Helium-like Au^{77+}. It was also possible to extract electron stripping and pick-up cross sections.

27887 (DOE/ER/13745–3) **Metastable enhancement of C^+ and O^+ capture reactions: Final report.** Thomas, E.W. Georgia Inst. of Tech., Atlanta, GA (United States). School of Physics. 31 Jul 1992. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-87ER13745. Order Number DE93015075. Source: OSTI; NTIS; INIS; GPO Dep.

The project is devoted to the study of charge transfer neutralization of Carbon and oxygen ions in H and H_2 gases at energies from 10 to 500 eV. A major motivation was to provide cross section data to support analysis of edge plasmas in Tokamak Fusion devices. The first objective was to measure cross sections for metastable excited singly charged ions separately from the cross sections for ground state ions. Previously published values are confusing because the beams used included unknown fractions of metastables and these metastables have cross sections greatly different from the ground states. The program was fully accomplished, metastable cross sections were found to be over an order of magnitude greater than ones for the ground state and existing discrepancies in the literature were resolved. Considerable effort was devoted to the design and operation of ion source configurations were the metastable content of the ion beam was known. Subsequently study progressed to the neutralization of multiply charged C and 0 ions in the same targets. First there has been a need to develop ion sources which can produce useful beams of multiply charged species. This has now been accomplished. The intent is to use these sources for the measurement of cross sections with again an attempt to differentiate between the behavior of ground and metastably excited species.

27888 (DOE/ER/14225–2) **Single-collision studies of energy transfer and chemical reaction: Progress report, April 1992–March 1993.** Valentini, J.J. Columbia Univ., New York, NY (United States). 1993. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-91ER14225. Order Number DE93017603. Source: OSTI; NTIS; INIS; GPO Dep.

The dynamics of the H + RH → H_2 + R (RH=CH_4, C_2H_6, C_3H_8, $CHCl_3$) were studied.

27889 (JINR-E–2-91-578) **Interaction of the Coulomb bound state of two elementary particles with atoms.** Afanas'ev, L.G. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Nuclear Problems. 1991. [18p.] Order Number DE93630105. Source: OSTI; NTIS (US Sales Only); INIS.

Submitted to Z. Phys., D.

Total, excitation and ionization cross section of the Coulomb bound state of two elementary particles (elementary atoms) interacting with atoms of H, C, N, Ar and Ta are calculated. Elementary atoms in the initial states 1s, 2s and 3s consisting of $\pi^+\pi^-$, $\pi\mu$, πK and e^+e^- pairs are studied. Exact analytic formulas for a large number of elementary atom form factors for discrete-discrete level transitions are given. 21 refs.; 18 tabs.

27890 (LA-UR–93-2155) **The cooling of confined ions driven by laser beams.** Reyna, L.G. (International Business Machines Corp., Yorktown Heights, NY (United States). Thomas J. Watson Research Center); Sobehart, J.R. Los Alamos National Lab., NM (United States). [1993]. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9309185–1: Fluctuations and order: the new synthesis workshop, Los Alamos, NM (United States), 9-12 Sep 1993). Order Number DE93016612. Source: OSTI; NTIS; INIS; GPO Dep.

We finalize the dynamics of confined ions driven by a quantized radiation field. The ions can absorb photons from an incident laser beam and relax back to the ground state by either induced emissions or spontaneous emissions. Here we assume that the absorption of photons is immediately followed by spontaneous emissions, resulting in single-level ions perturbed by the exchange of momentum with the radiation field. The probability distribution of the ions is calculated using singular expansions in the low noise asymptotic limit. The present calculations reproduce the quantum results in the limit of heavy particles in static traps, and the classical results of ions in radio-frequency confining wells.

27891 (NEI-DK–1154) **Electron-ion recombination at low energy.** Andersen, L.H. Aarhus Univ. (Denmark). Naturvidenskabeligt Fakultet. 1993. [96p.] Order Number DE93631920. Source: OSTI; NTIS; INIS.

The work is based on results obtained with a merged-beams experiment. A beam of electronics with a well characterized density and energy distribution was merged with a fast, monoenergetic ion beam. Results have been obtained for radiative recombination and dielectronic recombination at low relative energies (0 to ≈70eV). The obtained energy resolution was improved by about a factor of 30. High vacuum technology was used to suppress interactions with electrons from the environments. The velocity distribution of the electron beam was determined. State-selective dielectronic-recombination measurements were performable. Recombination processes were studied. The theoretical background for radiative recombination and Kramers' theory are reviewed. The quantum mechanical result and its relation to the semiclassical theory is discussed. Radiative recombination was also measured with several different non-bare ions, and the applicability of the semiclassical theory to non-bare ions was investigated. The use of an effective charge is discussed. For dielectronic recombination, the standard theoretical approach in the isolated resonance and independent-processes approximation is debated. The applicability of this method was tested. The theory was able to reproduce most of the experimental data except when the recombination process was sensitive to couplings between different electronic configurations. The influence of external perturbing electrostatic fields is discussed. (AB) (31 refs.).

27892 (NIFS-DATA–20) **Bibliography on electron transfer processes in ion-ion/atom/molecule collisions (updated 1993).** Tawara, H. National Inst. for Fusion Science, Nagoya (Japan). Apr 1993. 275p. Order Number DE93508346. Source: OSTI; NTIS; INIS.

Following our previous compilations [IPPJ-AM-45 (1986), NIFS-DATA-7 (1990)], bibliographic information on experimental and theoretical studies on electron transfer processes in ion-ion/atom/molecule collisions is up-dated. The references published through 1980-1992 are included. For easy finding references for particular combination of collision partners, a simple list is also provided. (author) 1542 refs.

27893 (UCRL-JC–111717) **Indirect processes in electron impact ionization of Kr^{24+} and Kr^{25+}.** Chen, M.H.; Reed, K.J. Lawrence Livermore National Lab., CA (United States). Sep 1992. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-920948–13: 6. international conference on physics of highly charged ions, Manhattan, KS (United States), 28 Sep - 2 oct 1992). Order Number DE93014129. Source: OSTI; NTIS; INIS; GPO Dep.

Electron-impact ionization cross sections have been calculated for magnesiumlike Kr^{24+} and sodiumlike Kr^{25+}. Electron-impact ionization is an important atomic process in hot dense plasmas. It can affect the ionization balance, electron temperature, electron density, and level population in the plasma. In the past decade, theoretical and experimental studies have revealed that indirect processes can make significant contributions to the cross sections for electron impact ionization of positive ions. The most important indirect process is excitation of an inner-shell electron followed by Auger emission. Higher-order processes such as resonant excitation followed by sequential double Auger emission, can also contribute significantly. The contributions of excitation-autoionization and resonant excitation double autoionization (REDA) were included, in addition to the cross sections for direct ionization of a 3s electron. The calculations were carried out using the relativistic distorted wave methods and the multiconfiguration Dirac-Fock model. For Kr^{25+}, the total cross section is about 5 times the direct ionization cross section. For the Kr^{24+}, the indirect contribution is about 2.5 times the direct ionization cross section. The REDA process produces many strong resonances and contributes about 20% to the average ionization cross section.

6644 Experimentally Derived Information On Atomic and Molecular Properties

Refer also to citation(s) 25911

27894 (K/ETO–127) **Multiphoton ionization studies of WF_6 and UF_6.** Harkins, D.A. (Oak Ridge K-25 Site, TN (United States)); Armstrong, D.P.; Compton, R.N.; Ding, Dajun. Oak Ridge K-25 Site, TN (United States); Oak Ridge National Lab., TN (United States). [1993]. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OT21400 ;AC05-76OR00001. (CONF-9306125–2: 6. international conference on multiphoton processes, Quebec City (Canada), 25-30 Jun 1993). Order Number DE93016232. Source: OSTI; NTIS; INIS; GPO Dep.

Multiphoton ionization of UF_6 and WF_6 has been studied from low ($\sim 10^5$) to high ($\sim 10^{16}$ W/cm^2) power density. The role of "collective states" in MPI is considered.

27895 (UCRL-JC–113277) **Observation of nonsequential ionization of helium and its impact on intensity monitoring.** Fittinghoff, D.N. (California Univ., Davis, CA (US). Dept. of Applied Science); Bolton, P.R.; Chang, B.; Kulander, K.C. Lawrence Livermore National Lab., CA (United States). 19 Mar 1993. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-930159–45: OE/LASE '93: International Society for Optical Engineering (SPIE) conference, Los Angeles, CA (United States), 16-23 Jan 1993). Order Number DE93017174. Source: OSTI; NTIS; GPO Dep.

The authors have measured the ion yields for helium and neon ionized by 120 femtosecond, 614 nanometer laser pulses with intensities up to 10^{16} watts per square centimeter. They have found that the He II and Ne II data exhibit features incompatible with standard nonresonant sequential ionization. These features reduce the usefulness of optical field ionization for monitoring laser intensity. For the experiment, they expect dynamic resonances to have little effect on the ionization, and they attribute the features to nonsequential ionization based on the simultaneous saturation of the features and the singly ionized charge states.

6645 Special Atoms and Molecules

Refer also to citation(s) 27889

27896 (JINR-R–4-92-152) **Simple effective adiabatic representation for three-body problem and modelling the transition of quasistationary state in weakly bound state for dt mesic molecule.** Vinitskij, S.I.; Puzynin, I.V.; Puzynina, T.P. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Computing Techniques and Automation. 1992. [12p.] (In Russian). Order Number DE93630146. Source: OSTI; NTIS (US Sales Only); INIS.

Submitted to Yad. Fiz.

The effective adiabatic approach to analysis of three-particle interaction is presented. It gives possibility to represent even in a simple two-level approximation all quality peculiarities of mesic atomic resonance reactions and to obtain good quantitative agreement with different cumbersome calculations. 15 refs.; 6 figs.

27897 (JINR-R–11-92-126) **The rise of accuracy for the multichannel scattering problem solving.** Vinitskij, S.I.; Puzynin, I.V.; Smirnov, Yu.S. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Computing Techniques and Automation. 1992. [22p.] (In Russian). Order Number DE93630145. Source: OSTI; NTIS (US Sales Only); INIS.

The Newton's iterative algorithm for solving the multichannel scattering problem for a system of the Schroedinger radial equations is presented. A discrete approximation of the problem is based on the finite-difference scheme of the n-th order accuracy with respect to a characteristic step h of the quasi-uniform mesh Ω_h. The calculations of the wave functions, phase shifts and cross sections of elastic and inelastic collisions of mesic atoms $(d\mu)_{1s}$ and $(p\mu)_{1s}$ with nuclei t and p were fulfilled in framework of simple approach of two-level adiabatic approximation for the collision energy values 0.001 eV - 50 eV. As compared with other works more accurate results for the characteristics of the scattering processes $(d\mu)_{1s}$+t and $(t\mu)_{1s}$+d near thresholds in the region 0.001 eV $\leq E \leq$0.3 eV were obtained. A correct monotonic behaviour of the partial reaction matrix K^1 elements was achieved for this region of the energy and for values of the total orbital momentum 1=0, 1, 2, 3. 20 refs.; 8 figs.; 6 tabs.

6650 Physics of Condensed Matter

Refer also to citation(s) 26568, 26575, 26709, 26920, 27879, 28153

27898 (DOE/ER/45334–6) **Electronic states in systems of reduced dimensionality: Progress report, October 15, 1992–October 14, 1993.** Ulloa, S.E. Ohio Univ., Athens, OH (United States). 20 May 1993. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-87ER45334. Order Number DE93014440. Source: OSTI; NTIS; INIS; GPO Dep.

The common theme of the research is the effects of electronic interactions on the properties of systems. Specifically, work was done in the following areas: magnetically modulated systems, Raman and EELS in superlattices, ballistic quantum interference effects, quantum dot arrays, and optical response of undoped fullerene crystals.

27899 (IC–93/80) **Ising model on tangled chain - 1: Free energy and entropy.** Mejdani, R. International Centre for Theoretical Physics, Trieste (Italy). Apr 1993. [15p.] Order Number DE93628792. Source: OSTI; NTIS (US Sales Only); INIS.

In this paper we have considered an Ising model defined on tangled chain, in which more bonds have been added to those of pure Ising chain. to understand their competition, particularly between ferromagnetic and antiferromagnetic bonds, we have studied, using the transfer matrix method, some simple analytical calculations and an iterative algorithm, the behaviour of the free energy and entropy, particularly in the zero-field and zero temperature limit, for different configurations of the ferromagnetic tangled chain and different types of addition interaction (ferromagnetic or antiferromagnetic). We found that the condition J=J' between the ferromagnetic interaction J along the chain and the antiferromagnetic interaction J' across the chain is somewhat as a "transition-region" condition for this behaviour. Our results indicate also the existence of non-zero entropy at zero temperature. (author). 17 refs, 8 figs.

27900 (IC–93/86) **Electron paramagnetic resonance of the ns^1 centers in crystals.** Nistor, S.V. (Antwerp Univ. (UIA), Wilrijk-Antwerpen (Belgium). Physics Dept.); Ursu, I. International Centre for Theoretical Physics, Trieste (Italy). May 1993. [49p.] Order Number DE93628793. Source: OSTI; NTIS (US Sales Only); INIS.

The results of the EPR studies concerning the paramagnetic centers with ns^1 (N=n>2) outer electronic configuration contained in crystals are reviewed. Such centers, with $^2S_{1/2}$ ground state, are produced by electron trapping at impurities of the IB and IIB group or by hole trapping at impurities of the IIIB and IV group of elements. The production and structural properties of such centers consisting of ns^1 ions (atoms) at various sites in the crystal lattice with different configurations of neighbouring defects are discussed in connection with their EPR characteristics. Tables containing the spin Hamiltonian parameters of all ns^1 centers reported in the literature until the end of year 1992 are given. (author). 146 refs, 14 tabs.

27901 (IC–93/90) **Ising model on tangled chain - 2: Magnetization and susceptibility.** Mejdani, R. International Centre for Theoretical Physics, Trieste (Italy). May 1993. [21p.] Order Number DE93628794. Source: OSTI; NTIS (US Sales Only); INIS.

In the preceding paper we have considered an Ising model defined on tangled chain to study the behaviour of the free energy and entropy, particularly in the zero-field and zero-temperature limit. In this paper, following the main line and basing on some results of the previous work, we shall study in the "language" of state configurations the behaviour of the magnetization and the susceptibility for different conditions of the model, to understand better the competition between the ferromagnetic bonds along the chain and the antiferromagnetic additional bonds across the chain. Particularly interesting is the behaviour of the susceptibility in the zero-field and zero-temperature limit. Exact solutions for the magnetization and susceptibility, generated by analytical calculations and iterative algorithms, are described. The additional bonds, introduced as a form of perfectly disorder, indicate a particular effect on the spin correlation. We found that the condition J=-J' between the ferromagnetic interaction J along the chain and the antiferromagnetic interaction J' across the chain is somewhat as a "transition-region" condition for this behaviour. (author). 16 refs, 14 figs.

27902 (IC–93/114) **Crystal anharmonicity in Li(H,D) and Na(H,D) systems.** Islam, A.K.M.A. (International Centre for Theoretical Physics, Trieste (Italy)); Haque, E.; Azad, A.S. International Centre for Theoretical Physics, Trieste (Italy). May 1993. [18p.] Order Number DE93632043. Source: OSTI; NTIS (US Sales Only); INIS.

The reliability of our recently developed potential model is tested by extending the study to various anharmonic properties, e.g., third order elastic constants, fourth order elastic constants, Grueneisen parameters, and the pressure derivatives of second order elastic constants of hydrides and deuterides of lithium and sodium. A comparison of the calculated properties with the available experimental results and other theoretical estimates shows the validity and reliability of the derived potential in the study of crystal anharmonicities also. (author). 43 refs, 2 figs, 4 tabs.

27903 (LA-UR–93-1755) **Particle interations in concentrated suspensions.** Mondy, L.A. (Sandia National Labs., Albuquerque, NM (United States)); Graham, A.L.; Abbott, J.R.; Brenner, H. Los Alamos National Lab., NM (United States). [1993]. 12p. Sponsored by USDOE, Washington, DC (United States); Department of Defense, Washington, DC (United States). DOE Contract W-7405-ENG-36 ;AC04-76DP00789. (CONF-9305134–1: 11. symposium on energy engineering sciences, Argonne, IL (United States), 3-5 May 1993). Order Number DE93014570. Source: OSTI; NTIS; GPO Dep.

An overview is presented of research that focuses on slow flows of suspensions in which colloidal and inertial effects are negligibly small. We describe nuclear magnetic resonance imaging experiments to quantitatively measure particle migration occurring in concentrated suspensions undergoing a flow with a nonuniform shear rate. These experiments address the issue of how the flow field affects the microstructure of suspensions. In order to understand the local viscosity in a suspension with such a flow-induced, spatially varying concentration, one must know how the viscosity of a homogeneous suspension depends on such variables as solids concentration and particle orientation. We suggest the technique of falling ball viscometry, using small balls, as a method to determine the effective viscosity of a suspension without affecting the original microstructure significantly. We also describe data from experiments in which the detailed fluctuations of a falling ball's velocity indicate the noncontinuum nature of the suspension and may lead to more insights into the effects of suspension microstructure on macroscopic properties. Finally, we briefly describe other experiments that can be performed in quiescent suspensions (in contrast to the use of conventional shear rotational viscometers) in order to learn more about boundary effects in concentrated suspensions.

27904 (RISO-R–660(EN)) **Annual progress report of the Department of Solid State Physics 1. January - 31 December 1992.** Skov Pedersen, J.; Lebech, B.; Lindgaard, P.-A. (eds.). Risoe National Lab., Roskilde (Denmark). Solid State Physics Dept. Jan 1993. [164p.] Order Number DE93630213. Source: OSTI; NTIS; INIS.

Research in the department is in the field of condensed matter physics. The principal activities of the department in the period from 1 january, to 31 December, 1992, are presented in this Progress Report. The department's research is predominantly experimental - utilising diffraction of neutrons and X-rays - and includes studies of two- and three-dimensional structures, magnetic ordering, heavy fermions, high T_c superconductivity, phase transitions in model systems, precipitation phenomena, and nano-scale structures in various materials. The major interest of the department is in basic research but projects of a more applied nature are often up, prompted by the applicability of the developed techniques and expertise. For clarity, the contributions to this report are organized into 12 categories with the following headings: Theory, Monte Carlo simulations, and methods for data analysis. Magnetic structures, magnetic phase transitions,and spin dynamics. High T_c superconductivity. Structures and structural phase transitions. Inclusions and precipitates in alloys and metals. Interaction of particles and photons with surfaces. Surfaces, interfaces, and amorphous structures. Langmuir films. Polymers. Microemulsions and biological systems. Instrumental developments. Other activities. (au) (1 tab., 101 ills., 165 refs.).

27905 (UCRL-JC–110945) **Volume dependence of Anderson hybridization in cubic CeCd and CeAg.** Monachesi, P. (L'Aquila Univ. (Italy). Dipt. di Fisica); Continenza, A.; Andreani, L.C.; McMahan, A.K. Lawrence Livermore National Lab., CA (United States). Sep 1992. 13p. Sponsored by USDOE, Washington, DC (United States); Swiss National Science Foundation, Bern (Switzerland); Consiglio Nazionale delle Ricerche, Rome (Italy). DOE Contract W-7405-ENG-48. (CONF-921201–16: 37. annual conference on magnetism and magnetic materials, Houston, TX (United States), 1-4 Dec 1992). Order Number DE93013081. Source: OSTI; NTIS; GPO Dep.

We have undertaken a first-principles theoretical study of the Anderson hybridization in cubic CeCd and CeAg as a function of volume reduction. We present results for the hybridization width $\Delta(\epsilon)$ in both the J = 5/2 multiplet and in the Γ_8, Γ_7 crystal field states of the f^1 Ce configuration. We also calculate the hybridization contribution to the magnetic transition temperature. This is found to increase with pressure but is smaller than the experimental values, indicating that the Coulomb exchange contribution to the magnetic coupling is not negligible in these compounds.

27906 (UCRL-JC–112287) **Numerical simulations and experiments on physics of high Mach number shockwave – turbulent flow interactions.** Buckingham, A.C. (Lawrence Livermore National Lab., CA (United States)); Grun, J. Lawrence Livermore National Lab., CA (United States). Dec 1992. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9303126–3: 4. international workshop on the physics of compressible turbulent mixing, Cambridge (United Kingdom), 29 Mar - 1 apr 1993). Order Number DE93013424. Source: OSTI; NTIS; GPO Dep.

When a shock moves into and interacts with an existing turbulent field, a substantial enhancement of the after-shock turbulent intensity and a simultaneous distortion and realignment of the tensor stress rate field and associated tensor stress field results. Component mixing, advective transport, and diffusion, as well as associated momentum and energy dissipation, are intensified over their pre-shocked levels. A combination of low preshocked turbulent

intensity and strong shocks (e.g. shock Mach numbers substantially greater than one) produces the most pronounced interactive change in the turbulence level. In contrast, when a weak shock (Mach number only slightly greater than one) moves through relatively intense up turbulence, the turbulence change is modest but dynamical distortion and erratic motion of the shock front is much more pronounced. It is a commonly held view that if the interactive shock Mach number is in the hypersonic range (shock Mach numbers equal to or greater than about 6), rapid reinforcement of shock strength at the front by non-linear pressure field interactions and consequent self-healing of shock front geometric irregularity would act to suppress front distortion and also suppress the influence of the shock interactions on the surrounding turbulence. In the present work, recent experiments, numerical large eddy simulations (LES), and analysis are presented which contradict this notion. This work suggests that pronounced shock front distortion and substantial interactive modification of the turbulence persists even for shocks propagating at shock Mach numbers well in excess of 100!

6651 Nuclear Techniques In Condensed Matter Physics

Refer also to citation(s) 25920, 27091, 27933

27907 (BNL–48361) **Local environment about O atoms in Pr-Y-Ba-Cu-O films studied by O K-edge XAFS.** Krol, A. (State Univ. of New York, Buffalo, NY (United States). Dept. of Physics); Soo, Y.L.; Huang, S.; Ming, Z.H.; Song, L.W.; Kao, Y.H.; Smith, G.C. Brookhaven National Lab., Upton, NY (United States). Sep 1992. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016 ;FG02-87ER45283. (CONF-920944–7: 6. annual New York State Institute on Superconductivity (NYSIS) conference on superconductivity and applications, Buffalo, NY (United States), 15-17 Sep 1992). Order Number DE93016218. Source: OSTI; NTIS; INIS; GPO Dep.

The local environment about oxygen atoms in $Pr_xY_{1-x}Ba_2Cu_3O_7$ films obtained by laser ablation has been investigated by means of the x-ray absorption fine structure (XAFS) spectroscopy at the O K-edge. It has been found that the Pr atoms do not substitute for the Cu atoms nor form interstitial defects in the CuO_2 planes and that the presence of Pr dopant does not disturb the local environment of oxygen.

27908 (BNL–48895) **Magnetic effects in anomalous dispersion.** Blume, M. Brookhaven National Lab., Upton, NY (United States). [1992]. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-9208186–2: International conference on anomalous scattering (ICAS), Hamburg (Germany), 17-21 Aug 1992). Order Number DE93014291. Source: OSTI; NTIS; INIS; GPO Dep.

Spectacular enhancements of magnetic x-ray scattering have been predicted and observed experimentally. These effects are the result of resonant phenomena closely related to anomalous dispersion, and they are strongest at near-edge resonances. The theory of these resonances will be developed with particular attention to the symmetry properties of the scatterer. While the phenomena to be discussed concern magnetic properties the transitions are electric dipole or electric quadrupole in character and represent a subset of the usual anomalous dispersion phenomena. The polarization dependence of the scattering is also considered, and the polarization dependence for magnetic effects is related to that for charge scattering and to Templeton type anisotropic polarization phenomena. It has been found that the strongest effects occur in rare-earths and in actinides for M shell edges. In addition to the scattering properties the theory is applicable to "forward scattering" properties such as the Faraday effect and circular dichroism.

27909 (DOE/ER/60721–6) **Quasi-elastic neutron scattering studies of protein dynamics: Progress report, November 1, 1992–May 25, 1993.** Rorschach, H.E. Rice Univ., Houston, TX (United States). Dept. of Physics. 25 May 1993. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-88ER60721. Order Number DE93015074. Source: OSTI; NTIS; INIS; GPO Dep.

Results that shed new light on the study of protein dynamics were obtained by quasi-elastic neutron scattering. The triple axis instrument H-9 supplied by the cold source was used to perform a detailed study of the quasi-elastic spectrum and the Debye-Waller factor for trypsin in powder form, in solution, and in crystals. A preliminary study of myoglobin crystals was also done. A new way to view the results of quasi-elastic scattering experiments is sketched, and the data on trypsin are presented and analyze according to this new picture.

27910 (LBL–31852) **Applications of the Advanced Light Source to problems in the earth, soil, and environmental sciences report of the workshop.** Lawrence Berkeley Lab., CA (United States). Oct 1992. 130p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-911288–: Applications of the Advanced Light Source to problems in the earth, soil, and environmental sciences, San Francisco, CA (United States), 11 Dec 1991). Order Number DE93015258. Source: OSTI; NTIS; INIS; GPO Dep.

This report discusses the following topics: ALS status and research opportunities; advanced light source applications to geological materials; applications in the soil and environmental sciences; x-ray microprobe analysis; potential applications of the ALS in soil and environmental sciences; and x-ray spectroscopy using soft x-rays: applications to earth materials.

27911 (LBL–34118) **Strain distribution in heterolayers with low misfit as revealed by convergent beam illumination methods.** Liliental-Weber, Z. (Lawrence Berkeley Lab., CA (United States)); Kaneyama, T.; Terauchi, M.; Tanaka, M. Lawrence Berkeley Lab., CA (United States). Nov 1992. 4p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract AC03-76SF00098. Contract AFOSR-ISSA-90-0009. (CONF-921101–128: 16. Material Research Society international symposium on the scientific basis for nuclear waste management fall meeting, Boston, MA (United States), 30 Nov - 5 dec 1992). Order Number DE93015043. Source: OSTI; NTIS; GPO Dep.

Convergent beam electron diffraction (CBED) was applied to the local measurement of lattice parameter across a strained interface with small mismatch. GaAs layers grown at low temperature with excess As (with 0.15% misfit) on a GaAs substrate were chosen for these studies. Tetragonal distortion was detected in the layer up to 0.5 μm from the interface. With an increase of the layer thickness lowering of the symmetry of these CBED patterns was observed. This lowering of symmetry is most probably due to saturation of As solubility and the strain build into these layers.

27912 (SLAC–417) **Nuclear dynamical diffraction using synchrotron radiation.** Brown, D.E. Stanford Linear Accelerator Center, Menlo Park, CA (United States). May 1993. 306p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00515. (SLAC/SSRL–0027). Order Number DE93016172. Source: OSTI; NTIS; INIS; GPO Dep.

The scattering of synchrotron radiation by nuclei is extensively explored in this thesis. From the multipole electric field expansion resulting from time-dependent nonrelativistic perturbation theory, a dynamical scattering theory is constructed. This theory is shown, in the many particle limit, to be equivalent to the semi-classical approach where a quantum mechanical scattering amplitude is used in the Maxwell inhomogeneous wave equation. The Moessbauer specimen whose low-lying energy levels were probed is a ferromagnetic lattice of ^{57}Fe embedded in a yttrium iron garnet (YIG) crystal matrix. The hyperfine fields in YIG thin films were studied at low and room temperature using time-resolved quantum beat spectroscopy. Nuclear hyperfine structure quantum beats were measured using a fast plastic scintillator coincidence photodetector and associated electronics having a time resolution of 2.5 nsec. The variation of the quantum beat patterns near the Bragg [0 0 2] diffraction peak gave a Lamb-Moessbauer factor of 8.2 ± 0.4. Exploring characteristic dynamical features in the higher order YIG [0 0 10] reflection revealed that one of the YIG crystals had bifurcated into two different layers. The dynamics of nuclear superradiance was explored. This phenomenon includes the radiative speedup exhibited by a collective state of particles, and, in striking concurrence, resonance frequency shifts. A speedup of a factor of 4 in

the total decay rate and a beat frequency shift of $1\frac{1}{2}$ natural resonance linewidths were observed. Nuclear resonance scattering was also found to be a useful way of performing angular interferometry experiments, and it was used to observe the phase shift of a rotated quantum state. On the whole, nuclear dynamical diffraction theory has superbly explained many of the fascinating features of resonant magnetic dipole radiation scattered by a lattice of nuclei.

27913 (VTT-PUB–82) **Development and applications of the reverse neutron time-of-flight method with Fourier-type beam chopper.** Antson, O. (Technical Research Centre of Finland, Espoo (Finland). Reactor Lab.). Technical Research Centre of Finland, Espoo (Finland); Helsinki Univ. of Technology, Otaniemi (Finland). Sep 1991. [147p.] Order Number DE93630221. Source: OSTI; NTIS; INIS.

The thesis also includes seven previously published articles.

The neutron powder diffraction method has been applied to the crystal structure analysis of high-temperature superconductors such as $La_0.8Sr_0.2CuO_{4-\gamma}$, $YBa_2Cu_3O_{7-\gamma}$ and $Bi_2Sr_2CaCu_2O_{8+\gamma}$ optically active yttriumformate $Y(HCOO)_3$, and β phase of deuterated acetonitrile, CD_3CN. The structural information, containing symmetry, positional and thermal parameters, occupation factors and the order parameter, was obtained by measuring the coherent elastic scattering cross-section. The Rietveld profile refinement method was used for the extraction of structural parameters from experimental data. The diffraction spectra were obtained by measuring the time-of-flight distribution of neutrons with a Fourier-type beam chopper. The neutron diffraction spectrum is created by the on-line synthesis of the cross-correlation function between the beam modulation function and the detector intensity. Such an operational mode, called the reverse time-of-flight method, has many unique properties. The possibility of filtering out a low-frequency part of a diffraction spectrum, eg. incoherent background, by a properly selected band-pass filter has been studied. One of the practical applications of the reverse time-of-flight method, the Mini-Sfinks facility, is described with technical details, and its operational characteristics are compared with other high-resolution instruments.

6652 Solid-State Plasma

27914 (DOE/ER/13740–11) **Investigations of transitions from order to chaos in dynamical systems: Annual progress report.** Schmidt, G. Stevens Inst. of Tech., Hoboken, NJ (United States). Dept. of Physics and Engineering Physics. Mar 1993. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-87ER13740. Order Number DE93014438. Source: OSTI; NTIS; INIS; GPO Dep.

Work was carried out in the following areas: The Arter flow and fast dynamo in connection with astrophysical magnetic fields, chaotic ion motion in the magnetosphere, nonlinear waves in two-dimensional plasmas, stochastic webs and transport phenomena, and chaotic mixing.

6653 Interactions Between Beams and Condensed Matter

Refer also to citation(s) 26610, 26628, 26652, 26677, 26776, 27711, 27848

27915 (IFVE-OP–91-142) **Crystal optics of high energy γ-beams: 3.Dielectric permeability tensor in single crystals at proton energy of $\geq$1 GeV.** Maisheev, V.A.; Mikhalev, V.L.; Frolov, A.M. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov (Russian Federation). Inst. Fiziki Vysokikh Ehnergij. 1991. [26p.] (In Russian). Order Number DE93630228. Source: OSTI; NTIS (US Sales Only); INIS.

Using the conception of the single crystal as a region of electrical field, generated by spatially ordered atoms, we have determined the tensor of dielectric permeability for $\geq$ 1 GeV photons in the region of crystal orientation, which corresponds to $^{\pm}$- pair coherent production. The polarization characteristics of normal EM wave propagation in the crystals were found with the help of this tensor. In particular, it was shown, that there exist solutions of a dispersion equation for elliptied polarized waves. Other EM processes in the crystals, in particular, Cherenkov radiation of charged particles, were considered. 18 refs.; 6 figs.

27916 (INIS-mf–13544, pp. 25-33) **Processes of high-energy electron interaction with oriented single crystals.** Antipenko, A.P. (AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst.); Bochek, G.L.; Blazhevich, S.V. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 5.* [232p.] Order Number DE93630453. Source: OSTI; NTIS (US Sales Only); INIS.

Interaction of relativistic electrons (0.3 to 1.75 GeV) with crystal targets has been investigated both by theory and in experiments in order to clarify the mechanisms of γ-ray generation and the characteristic properties of damages of single-crystal e - γ - converters. Measured are the integral energy fluxes and spectral-angular parameters of γ-radiation from oriented (<111> axis) silicon single crystals with thicknesses ranging from 10 to 70000 m. The highest γ-energy flux density is observed for a Si thickness of 15 mm. The brightness of γ-radiation from oriented crystal of optimum thickness varies with the electron energy according to the $\approx E^3$ law. The analysis of γ-quantum yields and the rate of radiation damaging as functions of a single crystal thickness has shown that the damaging of aligned single crystals at large depth is essentially contributed by the generated γ-ray fluxes. 11 refs.; 4 figs. (author).

27917 (INIS-mf–13544, pp. 42-46) **Investigation of positron interaction with defects of the molybdenum irradiated by fast neutrons.** Dubov, M.E. (Moskovskij Fiziko-Tekhnicheskij Inst., Moscow (Russian Federation)); Svirida, S.V.; Artemova, M.B.; Shishkin, A.V. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 5.* [232p.] Order Number DE93630453. Source: OSTI; NTIS (US Sales Only); INIS.

With the hope of the positron annihilation method the samples of the molybdenum monocrystals, irradiated by fast neutrons to the doze of $2.7x10^{19}$n/cm^2 are investigated. The irradiation was performed at 60^{0}C. At lower annealing temperatures we observed positrons saturation trapping by vacancies, dislocations and dislocation loops, while at high annealing temperatures - the dominant trapping by the voids take place. Basing on the results of the positron lifetime measurements as temperature we present the analysis of the influence of the sample dislocation structure on the positron annihilation parameters. 9 refs.; 1 fig.; 1 tab. (author).

27918 (INIS-mf–13544, pp. 70-75) **Investigation of proton-irradiated platinum by Moessbauer spectroscopy.** Bogdanov, V.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk (Russian Federation). Fiziko-Ehnergeticheskij Inst.); Zakurkin, V.V.; Petrov, D.V.; Pen'kov, Yu.P. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 5.* [232p.] Order Number DE93630453. Source: OSTI; NTIS (US Sales Only); INIS.

The Moessbauer emission spectroscopy method has been applied to investigate the annealing of radiation damage in platinum (with the addition of ^{57}Co isotope) after irradiation with 1 MeV protons at 90 K to the dose of $5x10^{17}$cm^{-2}. The analysis of spectra evolution as a function of annealing temperature enabled four components to be highlighted alongside with the initial one that corresponds to the location of ^{57}Co atoms in a substitutional position of platinum lattice. From their thermal annealing character four "defect" sites are identified as followers: site 1 - as corresponding to the trapping at ^{57}Co probe atoms of hydrogen atoms, sites 2 and 3 - to the trapping of SIA-H complexes, and site 4 - to that of vacancy-H complexes. 10 refs.; 2 figs.; 1 tab. (author).

27919 (INIS-mf–13544, pp. 76-80) **Processes of primary radiation defect formation near dislocations and dislocation loops.** Gann, V.V. (AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst.); Marchenko, I.G. AN Ukrainskoj SSR, Kharkov

(Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 5.* [232p.] Order Number DE93630453. Source: OSTI; NTIS (US Sales Only); INIS.

The results of modelling calculations of dislocations and dislocation loops influence on formation and development of atom-atom collision chains are given. Processes of Frenkel pair formation are considered. An effect of "dynamic preference" was observed. 7 refs.; 3 figs. (J.P.).

27920 (INIS-mf–13544, pp. 47-54) **Hydrogen interaction with radiation defects of Fe and Mo.** Dubov, M.E. (Moskovskij Fiziko-Tekhnicheskij Inst., Moscow (Russian Federation)); Shishkin, A.V.; Artemova, M.B.; Svirida, S.V. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 5.* [232p.] Order Number DE93630453. Source: OSTI; NTIS (US Sales Only); INIS.

With the hope of the positron annihilation method the interaction of the hydrogen with the radiation defects of the iron and molybdenum samples, irradiated by fast neutrons are investigated. One stage of the hydrogen release in molybdenum and two in iron was observed during the annealing of the electrolytically charged samples. Hydrogen binding energies with the microvoids were calculated. On the base of the calculated positrons trapping rates the role of the dislocations as the hydrogen trapping centers are discussed. 8 refs.; 2 figs. (author).

27921 (INIS-mf–13544, pp. 134-141) **Atomistic computer simulation on interaction of point, linear and surface defects.** Bojko, V.S. (AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst.); Mazilova, T.I.; Sidorenko, I.N. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij. Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 5.* [232p.] Order Number DE93630453. Source: OSTI; NTIS (US Sales Only); INIS.

Results from computer simulation of interaction on atom level of point, linear and planar defects are analysed. Considered are: the behaviour of point defects in the step-containing dislocation core, annihilation of dislocations with opposite Burgers vectors, contact interaction between the dislocations having the same Burgers vectors and occurring in the adjacent slip planes, interaction of point defects (vacancies, He atoms) and their complexes with high-angle grain boundaries, interaction between dislocation cores and high-angle grain boundaries. Connection between the present results and the data from the experiment and the continuum theory is discussed. 21 refs.; 2 figs. (author).

27922 (INIS-mf–13544, pp. 142-149) **Use of median energy proton beams in radiation damage physics and in radiation material science.** Zelenskij, V.F. (AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst.); Neklyudov, I.M.; Ozhigov, L.S. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 5.* [232p.] Order Number DE93630453. Source: OSTI; NTIS (US Sales Only); INIS.

A mathematic modelling of radiation damages in steel, iron, chromium and nickel by 1-100 MeV protons and neutrons with energies covering the energy range of neutron spectra in existing and alternative nuclear installations was carried out. It indicates that proton beams with the energies up to 100 MeV can be used for imitation of material radiation damages by neutrons having different spectra and energies. 5 refs.; 7 figs.; 2 tabs. (J.P.).

27923 (INIS-mf–13546, pp. 38-45) **The modification of some steel properties under helium implantation.** Lysova, G.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk (Russian Federation). Fiziko-Ehnergeticheskij Inst.); Rudnev, S.I.; Panin, S.D.; Chernov, V.M.; Vishkarev, O.M.; Magerya, Yu.G.; Smirnov, V.A. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 7.* [226p.] Order Number DE93630373. Source: OSTI; NTIS (US Sales Only); INIS.

Radiation microstructure, micro topography of surface and microhardness changes of surface layers of some steels were investigated after 30 keV helium ion irradiation to fluences of 10-40 dpa ($2\text{-}8x10^{17}$ ion/cm^2) at irradiation temperatures from 150^{0}C to 600^{0}C. 5 refs.; 4 figs.; 1 tab. (author).

27924 (INIS-mf–13546, pp. 98-105) **The creep of zirconium and Zr-1%Nb alloy under non-stationary irradiation by helium ions.** Bibilashvili, Yu.K. (Moskovskij Inzhenerno-Fizicheskij Inst., Moscow (Russian Federation)); Vasil'ev, V.K.; Elesin, V.F. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 7.* [226p.] Order Number DE93630373. Source: OSTI; NTIS (US Sales Only); INIS.

The investigation of the creep of thin-sheet specimens of cold-worked zirconium and Zr-1% Nb alloy at one-axis loading and irradiation by helium ions is carried out. The differential measurement method being the basis of the test-installation construction allowed to observe the peculiarities connected with non-stationary conditions of the irradiation of the materials. The considerable post-irradiation deformation of specimens was detected the maximum rate of which can exceed the deformation rate under irradiation. The deformation value for unestablished post-irradiation-creep period depends on the value of total accumulated deformation. The results indicate a significant contribution of slipping into the deformation process. 9 refs.; 4 figs. (author).

27925 (JINR-E–14-92-178) **Deep ion implantation into manganin to modify its pressure and electrothermocharacteristics.** Wisniewski, R.; Slowinski, B. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of High Energy. 1992. [2p.] Order Number DE93630229. Source: OSTI; NTIS (US Sales Only); INIS.

On the grounds of previously obtained experimental data concerning the high energy (≈1 MeV/u) Ar and Xe ions implantation into manganin, two suggestions to create the manganin based systems having improved pressure and electro-thermocharacteristics are put forward. The first way is to fabricate a multilayer system with the resultant plateau of the temperature dependence of the relative resistance much broader than the initial one. The second way comes to the formation of some manganin based selfcompensating structure. 4 refs.

27926 (PNL-SA–22200) **Electron emission resulting from fast ion impact on thin metal foils: Implications of these data for development of track structure models.** DuBois, R.D.; Drexler, C.G. Pacific Northwest Lab., Richland, WA (United States). Apr 1993. 31p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-9304148–1: Department of Energy Monte Carlo workshop, Irving, CA (United States), 28-29 Apr 1993). Order Number DE93013506. Source: OSTI; NTIS; INIS; GPO Dep.

Experimental information useful in improving and testing theoretical models of energy deposition and redistribution in particle-condensed phase media is discussed. An overview of information available from previous, and ongoing, studies of the electron emission from thin foils is presented and the need for doubly differential electron energy and angular distribution data stressed. Existing data are used to demonstrate that precisely known, and controllable, surface and bulk conditions of the condensed-phase media are required for experimental studies of this type. Work in progress and improvements planned for future studies at the Pacific Northwest Laboratory are outlined.

27927 (SAND–93-0304C, pp. 3, Paper 1) **Interface roughness and x-ray reflectivity.** Slaughter, J.M.; Falco, C.M. Sandia National Labs., Albuquerque, NM (United States). [1993]. (CONF-921101–108: 16. Material Research Society international symposium on the scientific basis for nuclear waste management fall meeting, Boston, MA (United States), 30 Nov - 5 dec 1992). In *Interface roughness: What is it and how is it measured?.* 35p. Order Number DE93009797. Source: OSTI; NTIS.

Real multilayers have imperfect interfaces due to interdiffusion, faceting, or other imperfections. This presentation discusses how x-ray reflectivity may be used to assess the roughness of interfaces. An emphasis is placed on the geometry of x-ray interactions with matter.

27928 (UCRL-JC–112630) **The interaction of intense femtosecond laser pulses with solid targets.** Klem, D.E.; Darrow, C.; Lane, S.; Perry, M.D. Lawrence Livermore National Lab., CA (United States). 30 Dec 1992. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9303119–3: 5. short wavelength: physics with intense laser pulses, San Diego, CA (United States), 29-31 Mar 1993). Order Number DE93014415. Source: OSTI; NTIS; GPO Dep.

The absorption of 800 fsec Nd-glass laser pulses obliquely incident on solid targets is measured at intensities up to 10^{18} W/cm^2. The associated production of hard x-rays is also measured.

27929 (UCRL-JC–113163) **Kinetic simulations of ultra-intense laser plasma interactions and a novel method of generating odd harmonics.** Wilks, S.C. (Lawrence Livermore National Lab., CA (United States)); Kruer, W.L.; Mori, W.B. Lawrence Livermore National Lab., CA (United States). 11 Feb 1993. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-930159–34: OE/LASE '93: International Society for Optical Engineering (SPIE) conference, Los Angeles, CA (United States), 16-23 Jan 1993). Order Number DE93014418. Source: OSTI; NTIS; GPO Dep.

We report on computer simulation results for a new laser plasma interaction regime, concentrating on the collisionless, kinetic nature of the plasma motion. It is found that even for normal incidence, the absorption of the laser light by the plasma electrons near critical can be as high as 60%, and that the temperature of the hot electrons produced can be predicted simply by knowing the associated ponderomotive potential of the incident laser. We also describe a new odd harmonic generation mechanism due to the interaction of the laser with the plasma electrons near critical.

6654 Quantum Physics Aspects of Condensed Matter

665410 Superconductivity

Refer also to citation(s) 26741

27930 (ANL/MSD/CP–79586) **After seven years, where's the consensus?.** Norman, M.R. Argonne National Lab., IL (United States). Apr 1993. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-930367–6: Conference on spectroscopies in novel superconductors, Santa Fe, NM (United States), 17-19 Mar 1993). Order Number DE93015160. Source: OSTI; NTIS; GPO Dep.

It has been 7 years since the discovery of copper oxide superconductors, yet there is no consensus on the correct theory for this phenomenon. The theory can be divided into 3 groups: ordinary (phonons), exotic (AF spin fluctuations, nested Fermi liquid, excitons, spin bags, odd frequency pairing), and revolutionary (Luttinger liquid, spin-charge separation, gauge theories, anyons, marginal Fermi liquid). C-axis dispersion, dHvA, and magneto-oscillations are also discussed.

27931 (CONF-930202–10) **Experimental investigations of superconductivity in quasi-two-dimensional epitaxial copper oxide superlattices and trilayers.** Lowndes, D.H.; Norton, D.P. Oak Ridge National Lab., TN (United States). [1993]. 28p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Annual meeting of The Metallurgical Society; Denver, CO (United States); 21-25 Feb 1993. Order Number DE93015306. Source: OSTI; NTIS; INIS; GPO Dep.

Epitaxial trilayer and superlattice structures grown by pulsed laser ablation have been used to study the superconducting-to-normal transition of ultrathin (one and two c-axis unit cells) $YBa_2Cu_3O_{7-x}$ layers. The normalized flux-flow resistances for several epitaxial structures containing two-cell-thick $YBa_2Cu_3O_{7-x}$ films collapse onto the "universal" curve of the Ginzburg-Landau Coulomb Gas (GLCG) model. Analysis of normalized resistance data for a series of superlattices containing one-cell-thick $YBa_2Cu_3O_{7-x}$ layers also is consistent with the behavior expected for quasi-two-dimensional layers in a highly anisotropic, layered three-dimensional superconductor. Current-voltage measurements for one of the trilayer structures also are consistent with the normalized resistance data, and with the GLCG model. Scanning tunneling microscopy, transmission electron microscopy, and electrical transport studies show that growth-related steps in ultrathin $YBa_2Cu_3O_{7-x}$ layers affect electrical continuity over macroscopic distances, acting as weak links. However , the perturbation of the superconducting order parameter can be minimized by utilizing hole-doped buffer and cap layers, on both sides of the $YBa_2Cu_3O_{7-x}$ layer, in trilayers and superlattices. These results demonstrate the usefulness of epitaxial trilayer and superlattice structures as tools for systematic, fundamental studies of high-temperature superconductivity.

27932 (LA-UR–93-1384) **Effect of spontaneous decay of superconductor quasiparticles in the tunneling density of states.** Coffey, D. Los Alamos National Lab., NM (United States). [1993]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930367–3: Conference on spectroscopies in novel superconductors, Santa Fe, NM (United States), 17-19 Mar 1993). Order Number DE93012681. Source: OSTI; NTIS; INIS; GPO Dep.

Superconductivity has been successfully described with either the Landau-Ginzburg theory of second order phase transitions or with strong-coupling versions of the original BCS theory for almost fifty years. Recent tunneling and photoemission data on the cuprate oxide superconductors may now provide evidence of corrections to the mean field approximation. It has been shown by Zasadzinski et al. that there is a dip at eV $\simeq 3\Delta_0$ in the SIS tunneling conductance, which is the derivative of the current across a superconductor-insulator-superconductor junction with respect to the applied voltage, for a set of cuprate superconductors whose T_c's range from 5.5K to 100K. Recently L. Coffey and I proposed an explanation of this feature in terms of the spontaneous decay of mean field quasiparticles. We showed that corrections to the mean field approximation for a superconductor lead to different frequency thresholds for spontaneous quasiparticle decay with different superconductor order parameter symmetries. These effects lead to features in the superconductor density of states and in the SIS tunneling conductance and provide experimental evidence of d-wave symmetry for the superconductor order parameter in the cuprates. I discuss model and also evidence of quasiparticle decay in ARPES data on $Bi_2Sr_2CaCu_2O_8$.

27933 (LA-UR–93-1736) **Muon spin relaxation studies of heavy fermion superconductors.** Heffner, R.H. Los Alamos National Lab., NM (United States). [1993]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9304145–2: International workshop on low energy muon science (LEMS '93), Santa Fe, NM (United States), 4-8 Apr 1993). Order Number DE93014576. Source: OSTI; NTIS; INIS; GPO Dep.

This talk will focus recent developments in our understanding of heavy fermion (HF) superconductors and the role that positive muon spin relaxation (μSR) studies have played in helping to elucidate their properties. As illustrations two systems will be discussed: (1) UPd_2Al_3, one of the most recently discovered HF superconductors, which also displays coexisting magnetic order and (2) UBe_3 doped with small quantities Of Th substituted for U, which displays an interplay between its superconducting and magnetic ground states, leading to multiple superconducting states.

665420 Superfluidity

Refer also to citation(s) 27699

665430 Other Topics in Quantum Fluids and Solids

27934 (DOE/ER/40561–084) **The fractional quantum hall effect and the rotation group.** Ginocchio, J.N. (Los Alamos National Lab., NM (United States)); Haxton, W.C. Los Alamos National Lab., NM (United States); Washington Univ., Seattle, WA (United States). Inst. for Nuclear Theory. [1992]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG06-90ER40561 ;FG06-88ER40427. (CONF-9208164–3: 6. symmetries

in science, Bregenz (Austria), 2-7 Aug 1992). Order Number DE93010348. Source: OSTI; NTIS; INIS; GPO Dep.

The fractional quantum Hall effect is thought to be the result of correlations between electrons induced by their mutual interactions. This paper explores the consequences of these correlations numerically and analytically. The problem is mapped onto the surface of a sphere, so that the number of states in the first Landau level is finite. The following three sections review this geometry, give the matrix elements of the Coulomb interaction, and compare exact wave functions with the Laughlin/Haldane ground state ansatz for fractional fillings 1/m, m an odd integer. While this ansatz accounts for many of the J = 0 ground states found in numerical diagonalizations, it does not explain all such states. To make progress on this problem. A complete characterization of the most general four-particle J = 0 wave function is given, including an algebraic enumeration of the number of such states. This construction provides one example of a 2/3-filled state, the particle-hole conjugate of the 3-particle Laughlin/Haldane m = 3 state. This result suggests a generalization that may give the particle-hole conjugates of all Laughlin/Haldane states of arbitrary N: the construction depends on an equivalence of single-particle spinors of rank N/2 and ones formed by coupling the elementary spinors of N different particles. This result is further generalized to produce a wave function ansatz that may account for other fractional fillings of physical interest.

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27935 (DOE/FTR–93011660) **Travel to Japan for ITER meeting and expatriate fact finding activities: Foreign trip report, August 30–September 16, 1992.** Thome, R.J. Massachusetts Inst. of Tech., Cambridge, MA (United States). Plasma Fusion Center. 18 Sep 1992. 37p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-91ER54110. Order Number DE93011660. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This is a trip report on a meeting held in Japan in August–September 1992. US representatives travelled to Japan for discussions with representatives from Japan's Atomic Energy Research Institute (JAERI). Talks centered around various topics related to the forthcoming buildup at the site at Naka.

7003 Plasma Physics and Fusion Research

Refer also to citation(s) 26954, 28030, 28036, 28046, 28049, 28050

27936 (CIEMAT–706) **Experimental Evidence of Edge turbulence driven by multiple mechanisms in ATF.** Hidalgo, C. (Centro de Investigaciones Energeticas, Medioambientales y Tecnologicas (CIEMAT), Madrid (Spain)); Harris, J.M.; Uckran, T.; Manson, G.R.; Bell, J.D. Centro de Investigaciones Energeticas, Medioambientales y Tecnologicas (CIEMAT), Madrid (Spain). 1993. 16p. Order Number DE93502571. Source: OSTI; NTIS.

The scaling properties of edge fluctuations have been investigated using Langmuir probes in the edge region of the Advance Toroidal Facility (ATF). Fluctuations in the ion saturation current (I_s/I_s) and transport inferred from the fluctuations increase with increasing density gradient, while keeping unchanged local electron temperature. The modification of the electron temperature in the range (10-50) eV, Keeping constant the density profile, does not have any significant influence on I_s/I_s. In regions were $E_r/B \approx 0$, the poloidal phase velocity of the fluctuations is given by $V_p h \approx 2T_e L_n B$. More then one of any so far proposed mechanisms must be invoked to explain all the experimental observations.(Author)

27937 (CIEMAT–707) **A method for measuring plasma position in TJ-I Tokamak.** Quin, J.; TJ-I Team. Centro de Investigaciones Energeticas, Medioambientales y Tecnologicas (CIEMAT), Madrid (Spain). 1993. 22p. Order Number DE93502572. Source: OSTI; NTIS.

A method using pairs of Mirnov coils to measure the plasma position in TJ-I is presented. The simple toroidal filament model which neglects the effect of plasma current density profile has proven to be acceptable within the experimental accuracy. The effect of plasma current density profile remains to be small, if the plasma current density profile has a quadratic form. (Author)

27938 (CIEMAT–709) **Experimental evidence of significant temperature fluctuations in the plasma edge region of the TJ-I Tokamak.** Hidalgo, C.; Balbin, R.; Pedrosa, M.A.; Garcia-Cortes, I.; Ochando, M.A. Centro de Investigaciones Energeticas, Medioambientales y Tecnologicas (CIEMAT), Madrid (Spain). 1993. 14p. Order Number DE93502574. Source: OSTI; NTIS.

Density and temperature fluctuations have been measured in the plasma bulk side of the velocity shear location of the TJ-I tokamak using a foast swept Langmuir probe technique. Evidence of sustantial temperature fluctuations which are in phase close to opposition with the corresponding density fluctuations has been found. This result suggests the possible role of radiation in determining edge fluctuation levels and call into question the determination of the density and potential fluctuations from the Langmuir current-probe and floating potential fluctuations. (Author)

27939 (CIEMAT–710) **Characterization of He/CH_4 DC glow discharge plasmas by optical emission spectroscopy, mass spectrometry and actinometry.** De la Cal, E.; Tafalla, D.; Tabares, F.L. Centro de Investigaciones Energeticas, Medioambientales y Tecnologicas (CIEMAT), Madrid (Spain). 1993. 27p. Order Number DE93502575. Source: OSTI; NTIS.

The gas-phase kinetics responsible for the formation of some electronically excited radicals (CH) and atoms (H,He;Ar) in glow discharge plasmas of He-methane admixtures has been investigated under several conditions of gas composition and discharge current at a total initial pressure of 0.01 torr. Actinometry has been used to characterize the microscopic plasma parameters and, in combination with mass spectrometry and optical emission spectroscopy, to establish the formation mechanism of excited species. Very good correlation between CH emission intensity and carbon deposition rate has been found under all conditions. The effective cracking Kinetic constant for methane molecular depends on plasma conditions, its value ranging from ≈ 1 to 5x10"-10 cm"3 s"-1 as plasma current is increased, in good agreement with the expected value according to the actinometric results. (Author)

27940 (CIEMAT–711) **Kinetics of Hydrocarbon formation in a-C:H film deposition plasmas.** De la Cal, E.; Tabares, F.L. Centro de Investigaciones Energeticas, Medioambientales y Tecnologicas (CIEMAT), Madrid (Spain). 1993. 13p. Order Number DE93502576. Source: OSTI; NTIS.

The formation of C_2 and C_3 hydrocarbons during the PACVD of a-C-H films from admixtures of methane with H_2 and He has been investigated by mass espectrometry under several deposition condition. The time evolution of the observed species indicates that the formation mechanism of ethylene and acetylene are sensitive to the conditions of the wall during the growing of the film. Acetylene are sensitive to the conditions of the wall during the growing of the carburized metal. (Author)

27941 (CIEMAT–713) **Radial profile of the electron distribution from electron cyclotron emission measurements.** Tribaldos, V.; Krivenski, V. Centro de Investigaciones Energeticas, Medioambientales y Tecnologicas (CIEMAT), Madrid (Spain). 1993. 21p. Order Number DE93502577. Source: OSTI; NTIS.

A numerical study is presented, showing the possibility to invert the electron distribution function from a small set of non-thermal spectra, for a regime of lower hybrid current drive. (Author)

27942 (CONF-921103–11-App.B) **Helium transport scaling law studies.** Guo, Junpeng; Miley, G.H. Illinois Univ., Urbana, IL (United States). Fusion Studies Lab. Nov 1992. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-90ER54092. From Meeting of the Division of Plasma Physics of the American Physical Society; Seattle, WA (United States); 16-20 Nov 1992. Order Number DE93013487. Source: OSTI; NTIS; INIS; GPO Dep.

Impurity behavior within the tokamak fusion plasma will be a main concern for the future tokamak operation such as ITER. Thermalized alpha particles, i.e., helium "ashes" constitute a key impurity within the plasma core. The helium ash accumulation within the tokamak plasma not only dilutes the fusion fuel, but also enhances the radiation energy loss. Eventually, these effects can prevent the fusion ignition and degrade the fusion output power even after ignition. Great progress has been made in determining

the transport coefficients D(r) and V(r) with helium puffing and simulation techniques. Obviously, those results are only valid for a specific machine under certain plasma conditions. The extrapolation to other devices still remains a problem. Physically, alpha particle transport is determined by the local plasma conditions. Therefore, the D and V should be a function of the plasma parameters. In our research, we assume that the helium transport scaling law has the form of power law. By using the experiment data from helium puffing in L-mode deuterium plasma on TFRR, the scaling laws of D and V are obtained with the least square analysis. Also, the significance of helium transport scaling law to the design is discussed.

27943 (CONF-921103–12-App.A) **Direct determination of alpha particle transport coefficients: Appendix A.** Guo, J.; Miley, G.H. Illinois Univ., Urbana, IL (United States). Fusion Studies Lab. [1992]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-90ER54092. From Meeting of the Division of Plasma Physics of the American Physical Society; Seattle, WA (United States); 16-20 Nov 1992. Order Number DE93013488. Source: OSTI; NTIS; INIS; GPO Dep.

Many studies have been reported on the simulation of impurity transport phenomena in the Tokamak fusion plasma using the MIST code (1,2,3). The MIST code is to solve the multi-ionization state impurity transport equations by assuming that the transport fluxes of different ionization states are known. In most simulations, the transport fluxes of impurities are usually expressed in terms of diffusion coefficient and convective velocities. By considering the "inverse" problem (vs.MIST), the basic idea of this research is to solve the one dimensional (ONE-D, with cylindrical geometry) impurity transport equations to determine the transport coefficients from the experimental impurity density evolution data. We have developed a computer code which is labelled as "DASH" to solve this problem. The alpha particle transport coefficients can be obtained and inter-corrected by using the MIST and this DASH code. This code also provides a way to check the simulation results of MIST code.

27944 (CONF-930281–7) **The role of plasma rotation on MHD instabilities in tokamaks.** Varadarajan, V.; Miley, G.H. Illinois Univ., Urbana, IL (United States). Fusion Studies Lab. [1993]. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-90ER54092. From 6. transport task force workshop; Newport, RI (United States); 21-25 Feb 1993. Order Number DE93013486. Source: OSTI; NTIS; INIS; GPO Dep.

An improved analysis of the linear stage of the internal kink mode has been developed to include plasma rotation and finite aspect ratio effects. The linear instabiliy growth rates are increased by the plasma rotation. A pseudo-variational, bilinear formalism is used to discretize the linear instability equations; Fourier decomposition is used in the periodic coordinate, and a mixed-finite element procedure is adopted in the radial direction. The numerical studies with the resulting PEST-like code can be used to predict the complex plasma eigenfrequencies. The finite aspect ratio results are similar to the large aspect ratio results for flow instability. The complex instability frequencies found in the "fishbone" and TAE modes would be strong determined by the large plasma rotation velocities observed in present-day tokamak devices. These effects could be studied by using the computationally convenient bilinear form derived from the Frieman-Rotenberg equation.

27945 (CONF-9304112–10) **Ion cyclotron heating experiments and plans for the Advanced Toroidal Facility (ATF).** Rasmussen, D.A.; Batchelor, D.B.; Goulding, R.J.; Hoffman, D.J.; Jaeger, E.F.; Rome, J.A.; Thomas, C.E. Oak Ridge National Lab., TN (United States). [1993]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 10. topical conference on radio frequency power in plasmas; Boston, MA (United States); 1-3 Apr 1993. Order Number DE93012965. Source: OSTI; NTIS; INIS; GPO Dep.

Toroidal Facility (ATF) Ion Cyclotron Resonant Frequency (ICRF) experiments to date, a single-strap tunable antenna with carbon limiters has been used at power densities up to 13.6 MW/m^2 (900 kW). Hydrogen minority heating experiments at 14.4 MHz were performed in deuterium plasmas formed initially with both second-harmonic electron cyclotron heating (ECH) and helium neutral beam injection (NBI). No ICRF heating was observed in the low-density ECH target plasmas. Two distinct NBI plus ICRF operating modes are described. The moderate heating of these discharges is probably limited by impurities sputtered from the vessel walls and/or poorly confined orbits for the heated particles. A two-strap, phased antenna, designed to reduce impurities and capable of both minority and direct electron heating is described. A second antenna design for optimizing the coupling to well confined ion orbits, additional ICRF heating schemes, and methods for reducing the RF edge interactions in a stellarator geometry are also being considered.

27946 (CONF-9305231–1) **Nonlinear gyrofluid models of shear Alfven instabilities in ignited and beam heated toroidal plasmas.** Spong, D.A.; Hedrick, C.L.; Carreras, B.A. Oak Ridge National Lab., TN (United States). [1993]. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From International Atomic Energy Agency (IAEA) technical committee meeting; Trieste (Italy); 10-14 May 1993. Order Number DE93016235. Source: OSTI; NTIS; INIS; GPO Dep.

Shear Alfven instabilities driven by energetic beams and alpha populations are investigated using a reduced MHD-gyrofluid model with Landau closure. The moment equations for the fast ions are truncated in a way which incorporates the wave particle resonances that are required to destabilize the shear Alfven mode. These are coupled to an Ohm's law and vorticity equations which have been generalized to include ion FLR, electron and ion Landau damping. This model has been applied to experimentally observed regimes in a number of tokamak and stellarator devices. Both linearized growth rates and the nonlinear evolution are obtained. The saturated nonlinear regimes indicate mode number and frequency spectra which are generally consistent with experiment. A detailed examination of one typical nonlinear state has allowed identification of the dominant saturation mechanisms. This indicates that generation of n = 0, m = 0 sheared poloidal velocity flows and quasi linear modification of the q(r) profile can be important factors in reaching saturation.

27947 (CONF-930720–11) **Active probing of plasma edge turbulence and feedback studies on the Texas Experimental Tokamak (TEXT).** Uckan, T. (Oak Ridge National Lab., TN (United States)); Carreras, B.A.; Richards, B.; Bengtson, R.D.; Crockett, D.B.; Gentle, K.W.; Li, G.X.; Hurwitz, P.D.; Rowan, W.L.; Tsui, H.Y.W.; Wootton, A.J. Oak Ridge National Lab., TN (United States); Texas Univ., Austin, TX (United States). Fusion Research Center. [1993]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400 ;FG05-88ER53267. From 20. European conference on controlled fusion and plasma physics; Lisbon (Portugal); 26-30 Jul 1993. Order Number DE93015799. Source: OSTI; NTIS; INIS; GPO Dep.

The edge fluctuations play a critical role in the overall tokamak confinement. Experiments on TEXT show that electrostatic fluctuations in the edge plasma are the dominant mechanism for energy and particle transport. The basic mechanisms responsible for the edge turbulence are the subject of ongoing research in fusion devices. To understand the driving forces responsible for edge fluctuations, a novel experiment is underway on TEXT to actively modify the turbulence at the plasma edge by launching waves using electrostatic probes in the shadow of the limiter. This technique permits active probing of the spectral properties of the edge turbulence. This new approach to the study of edge fluctuations can provide more insight into the basic dynamics of the turbulence and may, in turn, enable detailed comparison with the theory. These experiments, which rely on the use of oscillating electric fields at the plasma edge, complement edge fluctuation control studies that are presently limited to the use of applied dc biasing to influence the edge electric field profile. These experiments have been extended to control of the edge plasma fluctuation level, using feedback to explore its effects on the edge turbulence characteristics as well as on confinement.

27948 (CONF-930720–12) **Equilibrium reconstruction of the q-profile in tokamaks from motional Stark effect data.** Hirshman, S.P. (Oak Ridge National Lab., TN (United States)); Lee, D.K.; Levinton, F.M.; Batha, S.H.; Okabayashi, M.; Wieland, R.M.

Oak Ridge National Lab., TN (United States). [1993]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 20. European conference on controlled fusion and plasma physics; Lisbon (Portugal); 26-30 Jul 1993. Order Number DE93015815. Source: OSTI; NTIS; INIS; GPO Dep.

The motional Stark effect (MSE) diagnostic has been implemented on the Tokamak Fusion Test Reactor (TFIR) and the Princeton Beta Experiment (PBX-M) to obtain q-profile measurements in the presence of a finite-β plasma. A multichannel MSE parameter system has obtained data for several plasma conditions including L-mode, Supershot, current ramps and high β_p. Accurate measurement of the q-profile is essential for analysis of the equilibrium, stability and transport properties of a tokamak. Many externally observed phenomena, such as sawteeth and the beta collapse, can be analyzed principally in terms of the q and q (i.e., shear) profiles. Thus, the MSE measurement supplements the standard diagnostic suite of external magnetic probes to provide a new set of internal profile data which was previously unavailable. Using the MSE data, together with magnetic probe data, it is possible to obtain a self-consistent equilibrium reconstruction of the q-profile. Before describing the reconstruction technique, a brief review of the MSE diagnostic will be in this paper.

27949 (DOE/ER/53297–5) **High beta and confinement studies of TFTR: Progress report, April 15, 1992–April 14, 1993.** Navratil, G.A. (Columbia Univ., New York, NY (United States)); Bhattacharjee, A.; Iacono, R.; Mauel, M.E.; Sabbagh, S.A.; Kesner, J. Columbia Univ., New York, NY (United States). [1993]. 49p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-89ER53297. Order Number DE93016204. Source: OSTI; NTIS; INIS; GPO Dep.

The project discussed in this report are: Enhanced High Poloidal Beta Operation in TFTR with Deuterium Pellet Injection; Approaching High Q by Utilizing High β_p Operation in TFTR; Advanced Tokamak Regime Experiment, and Second Regime Studies at large Major Radius High β_p Plasmas. Analysis of the data taken during these experiments as well as continuing analysis of earlier data led to a number important results described in publications in the past year including two invited presentations at the 1992 American Physical Society Division of Plasma Physics Meeting in Seattle an oral presentation at the 1992 IAEA Meeting in Wuertzburg, Germany, and a Physical Review Letter. These results included extending the high 11/2 regime to 1.2 MA current and neutron production rates to more than 3×10^{16} sec^{-1}; the first experiments with 4 sec neutral beam injection on TFRR; the creation of the first beam and bootstrap current sustained plasmas on TFTR for more than a current relaxation time scale; the first observation of ideal NM ballooning modes in a large tokamak; and production of plasmas with the inner 3/4 of the plasma in or with stable access to the second stability regime. The principal results of these papers and supporting theory work are summarized below.

27950 (DOE/ER/54131–2) **Growth curve analysis for plasma profiles using smoothing splines: Annual progress report, June 1992–June 1993.** Imre, K. College of Staten Island, NY (United States). May 1993. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-91ER54131. Order Number DE93015741. Source: OSTI; NTIS; INIS; GPO Dep.

We are developing a profile analysis code for the statistical estimation of the parametric dependencies of the temperature and density profiles in tokamaks. Our code uses advanced statistical techniques to determine the optimal fit, i.e. the fit which minimized the predictive error. For a forty TFTR Ohmic profile dataset, our preliminary results indicate that the profile shape depends almost exclusively on q_a' but that the shape dependencies are not Gaussian. We are now comparing various shape models on the TFTR data. In the first six months, we have completed the core modules of the code, including a B-spline package for variable knot locations, a data-based method to determine the optimal smoothing parameters, self-consistent estimation of the bias errors, and adaptive fitting near the plasma edge. Visualization graphics already include three dimensional surface plots, and discharge by discharge plots of the predicted curves with error bars together with the actual measurements values, and plots of the basis functions with errors.

27951 (DOE/FTR–93014803) **Travel to Japan to collaborate on kinetic stability of FRC: Foreign trip report, March 7–26, 1992.** Steinhauer, L.C. STI Optronics, Bellevue, WA (United States). 3 Apr 1992. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-80ER53098. Order Number DE93014803. Source: OSTI; NTIS (US Sales Only); GPO Dep.

To collaborate with A. Ishida (Niigata University) on kinetic stability of FRCs, and visit the institutions listed in the itinerary to learn of recent experimental and theoretical progress in FRC research.

27952 (ENEA-RT-NUCL–91-07) **Contributions to 18th conference on controlled fusion and plasma physics.** ENEA, Frascati (Italy). Dipt. Fusione. Apr 1991. 40p. (CONF-9106293–Exc.: 18. European conference on controlled fusion and plasma heating, Berlin (Germany), 3-7 Jun 1991; RT/NUCL–91-07). Order Number DE93799255. Source: OSTI; NTIS (US Sales Only); INIS.

From the Contributions to the 18th Conference on Controlled Fusion and Plasma Physics (Berlin, June 3-7, 1991), separate abstracts were prepared for 9 papers. The topics were: the role of parametric decay instabilities and edge plasma fluctuations on the current drive efficiency of lower hybrid waves; neutral density in FT ohmic plasma; linear propagation and absorption of ion Bernstein waves in toroidal geometry; pressure anisotropy in ohmic FTU (Frascati Tokamak Upgrade) discharges; charged particle injection and fusion product escape; tokamak transport and ohmic confinement; spatial distribution of fast electrons on Asdex; electron heat diffusivity from temperature perturbations in the FT and FTU tokamaks; and the effects of ion bounce resonance on ideal and resistive MHD instabilities.

27953 (ENEA-RT-NUCL–91-07, pp. 5-8) **Role of parametric decay instabilities and edge plasma fluctuations on current drive efficiency of lower hybrid waves.** Pericoli-Ridolfini, V.; Cesario, R. ENEA, Frascati (Italy). Apr 1991. (CONF-9106293–Exc.: 18. European conference on controlled fusion and plasma heating, Berlin (Germany), 3-7 Jun 1991; RT/NUCL–91-07). In *Contributions to 18th conference on controlled fusion and plasma physics.* 40p. Order Number DE93799255. Source: OSTI; NTIS (US Sales Only); INIS.

Experimental current drive efficiency of lower hybrid frequency waves at 2.45 GHz was found to be less than 50% of its maximum value in Asdex when some plasma parameters and/or vessel conditions were changed. The available theories and numerical simulations of lower hybrid current drive (LHCD) fail to explain this observation (all the main quantities considered were taken into account when experimental data were processed). The decrease of LHCD efficiency was instead very well correlated to the spectral broadening of the frequency spectrum of the launched LH pump, as detected by a RF probe situated just outside the plasma column. This was possibly due to a modification of its parallel refraction index spectrum. This paper presents an analysis of the causes of this broadening and searches for possible similar effects due to the other main feature of the frequency spectrum, i.e., ion cyclotron satellites. This last point was investigated by comparing the decrease of the loop voltage when the ion cyclotron side-bands were either present or absent, and by maintaining all the other parameters constant. The cause of spectral broadening, either parametric decay instabilities (PDI's) involving low frequency ion sound quasi modes, or scattering by density fluctuations, were investigated experimentally and theoretically.

27954 (ENEA-RT-NUCL–91-07, pp. 9-12) **Neutral density in FT ohmic plasma.** Bracco, G.; Moleti, A.; Zanza, V. ENEA, Frascati (Italy). Apr 1991. (CONF-9106293–Exc.: 18. European conference on controlled fusion and plasma heating, Berlin (Germany), 3-7 Jun 1991; RT/NUCL–92-07). In *Contributions to 18th conference on controlled fusion and plasma physics.* 40p. Order Number DE93799255. Source: OSTI; NTIS (US Sales Only); INIS.

In tokamak plasma, the information on neutral density in the plasma core is very poor. If the ion temperature profile is known, however, the measurement of the charge exchange neutrals allows the evaluation of neutral density and, hence, the estimation of particle sources and fluxes which can be compared with the theoretical forecasts. FT tokamak results showed that the experimental ion temperatures agree well with Chang Hinton neoclassical forecasts and therefore the ion temperature profile obtained as the

solution of the ion power balance with neoclassical thermal conductivity was used to analyze the neutral particle analyzer (NPA) spectra. The radial profile of the neutral density was evaluated by means of a 1-D neutral transport code which solves the continuity equation for neutrals in a way similar to the ANTIC code. This paper reports on the verification of the accuracy of the neutral density determination by the simulation of the NPA fluxes for different selected plasma discharges.

27955 (ENEA-RT-NUCL–91-07, pp. 13-16) **Theory of linear propagation and absorption of ion Bernstein waves in toroidal geometry.** Cardinali, A.; Romanelli, F. ENEA, Frascati (Italy). Apr 1991. (CONF-9106293–Exc.: 18. European conference on controlled fusion and plasma heating, Berlin (Germany), 3-7 Jun 1991; RT/NUCL–91-07). In *Contributions to 18th conference on controlled fusion and plasma physics.* 40p. Order Number DE93799255. Source: OSTI; NTIS (US Sales Only); INIS.

Ion Bernstein Waves (IBW) injection experiments carried out on the DIII-D tokamak at high power levels (1 MW) have shown a very peripherical wave absorption and no significant central ion heating. This paper attempts to find an explanation for this unsuccessful result within the framework of the linear theory of IBW propagation and absorption and without invoking non-linear theories such as the onset of parametric decay instability. The solution, by choosing an appropriate ordering scheme for the relevant parameters (perpendicular wave number, ion Larmor radius and mode frequency), of the ray tracing equations for IBW propagation in toroidal geometry shows an oscillating behaviour of the parallel refraction index and a strong dependence of its amplitude on the poloidal angle at the antenna or, alternatively, on the value of the poloidal angle at the lower hybrid conversion layer. The calculation of the absorption along the trajectory was also obtained showing that rays launched at poloidal angles greater than 5 degrees are absorbed at the plasma periphery because of the strong increase of the parallel refraction index.

27956 (ENEA-RT-NUCL–91-07, pp. 17-20) **Pressure anisotropy in ohmic FTU discharges.** Alladio, F.; Buratti, P.; Grolli, M.; Marinucci, M.; Podda, S.; Zerbini, M.; Zoffoli, M. ENEA, Frascati (Italy). Apr 1991. (CONF-9106293–Exc.: 18. European conference on controlled fusion and plasma heating, Berlin (Germany), 3-7 Jun 1991; RT/NUCL–91-07). In *Contributions to 18th conference on controlled fusion and plasma physics.* 40p. Order Number DE93799255. Source: OSTI; NTIS (US Sales Only); INIS.

Analysis of some FTU (Frascati Tokamak Upgrade) shots revealed a remarkable discrepancy, observed as a transient behaviour, in plasma cross-sectional shape with neutron emission and dynamic energy confinement time being remarkably enhanced. Both the onset and evolution of this phenomenon appear to be connected with the plasma position: for its onset, it seems necessary that the plasma is in contact with the external limiter and removed from the internal one to such an extent that no lines of force connect the two limiters. When, during the event, the plasma returns to the internal limiter, the discrepancy starts to decline. Pressure anisotropy in the electrons seems to be ruled out by the fact that no signs of non-Maxwellian distribution functions occur on the ECE spectra. Pressure anisotropy in the ion distribution function seems to be ruled out because of the behaviour of the neutron emission that follows the increase of the density and the returning of the ion temperature to the electron temperature at higher densities. Therefore, a possible tentative explanation is that the extra energy is due to the bulk plasma toroidal rotation (with a velocity of the order of the ion thermal velocity) induced by the plasma becoming non-neutral with the contemporaneous charging of the limiters that are both electrically floating.

27957 (ENEA-RT-NUCL–91-07, pp. 21-24) **Charged particle injection and fusion product escape in separatrix stellarators.** Alladio, F.; Batistoni, P.; Mancuso, S. ENEA, Frascati (Italy). Apr 1991. (CONF-9106293–Exc.: 18. European conference on controlled fusion and plasma heating, Berlin (Germany), 3-7 Jun 1991; RT/NUCL–91-07). In *Contributions to 18th conference on controlled fusion and plasma physics.* 40p. Order Number DE93799255. Source: OSTI; NTIS (US Sales Only); INIS.

The main difficulty in the design of low aspect ratio torsatron/stellarator configurations is the increase of the collisionless losses of the charged fusion products. Whereas high aspect ratio stellarators can obtain up to a fraction (f_c = 97%) of the fast fused ions, the prompt losses increase to (1 - f_c) = 33% at a plasma aspect ratio of around 3. The two major drawbacks connected with such prompt losses are the damages to the surrounding structures (such as the superconducting magnets) and the fact the plasma will start charging up negatively at a very high rate. In this paper, the three surface current (idealized) stellarators, all with a poloidal winding number of 2 and all endowed with pronounced with magnetic separatrix features, are considered. It is shown that: in separatrix endowed stellarators, the fast ion losses are strongly focussed far from the torsatron windings along the in-board upper part (with the toroidal magnet field component B_{phi} greater than 0) of one of the separatrix tails; and by injecting charged fusible nuclei from the in-board lower part of the outer separatrix tail, particles could be deposited well inside the magnetic configuration. Neither the injection energy nor the pitch angle of injection appear to be critical.

27958 (ENEA-RT-NUCL–91-07, pp. 25-28) **Tokamak transport and ohmic confinement.** Bartiromo, R. ENEA, Frascati (Italy). Apr 1991. (CONF-9106293–Exc.: 18. European conference on controlled fusion and plasma heating, Berlin (Germany), 3-7 Jun 1991; RT/NUCL–91-07). In *Contributions to 18th conference on controlled fusion and plasma physics.* 40p. Order Number DE93799255. Source: OSTI; NTIS (US Sales Only); INIS.

Heat transport in tokamaks is empirically characterized by the existence of different regimes - the LOC regime (confinement time linearly increasing with density), the SOC regime (energy confinement time saturating at high density), and L-mode (energy confinement time), irrespective of heating method, degrading with heating power and improving with plasma current. The aim of this paper is to derive, by the use of simple arguments and by imposing dimensional constraints, a scaling which describes the behaviour of each regime and allows the prediction of tokamak confinement. Ohmic data obtained from experiments on the Asdex and FT tokamaks are used to check the validity of the scaling. The existence of a main transport mechanism responsible for the observed confinement time in the three regimes is suggested.

27959 (ENEA-RT-NUCL–91-07, pp. 29-32) **Spatial diffusion of fast electrons during 2.45 GHz experiment on ASDEX.** Barbato, E.; Bartiromo, R.; Gabellieri, L.; Tuccillo, A.A. ENEA, Frascati (Italy). Apr 1991. (CONF-9106293–Exc.: 18. European conference on controlled fusion and plasma heating, Berlin (Germany), 3-7 Jun 1991; RT/NUCL–91-07). In *Contributions to 18th conference on controlled fusion and plasma physics.* 40p. Order Number DE93799255. Source: OSTI; NTIS (US Sales Only); INIS.

Modulation of RF power is a well known technique in the study of plasma power deposition profiles and transport processes. This paper reports on Lower Hybrid (LH) power modulation experiments on the Asdex tokamak. The spatial distribution of LH generated fast electrons were investigated by comparing the experimental results with a simulation model. Plasma response was studied by measuring bremsstrahlung emission from fast electrons in the photon energy range from 40 to 500 keV with two systems: the first recorded simultaneously the emission from three radial chords, the second looked tangentially on the equatorial plane with a tangency point variable varying from 40 cm on the inner side to 20 cm on the outer side of the magnetic axis on a shot by shot basis. Both systems used three inch NaI detectors with a standard electronics and data acquisition systems.

27960 (ENEA-RT-NUCL–91-07, pp. 33-36) **Determination of electron heat diffusity from temperature perturbations in FT and FTU tokamaks.** Berton, F.; Bruschi, A.; Buratti, P.; Imperiali, C.; Romanelli, F.; Tudisco, O. ENEA, Frascati (Italy). Apr 1991. (CONF-9106293–Exc.: 18. European conference on controlled fusion and plasma heating, Berlin (Germany), 3-7 Jun 1991; RT/NUCL–91-07). In *Contributions to 18th conference on controlled fusion and plasma physics.* 40p. Order Number DE93799255. Source: OSTI; NTIS (US Sales Only); INIS.

The evolution of electron temperature perturbations following sawtooth collapse was measured at different radial positions by electron cyclotron emission (ECE) and used to determine electron heat diffusivity (chi e^{HP}) in the Frascati FT and FTU (Frascati Tokamak Upgrade) tokamaks. The electron heat diffusivity values

obtained on FT, using the time-to-peak method, were compared with the values resulting from steady state power balance (chi e^{PB}). The comparative analysis showed that electron heat diffusivity, as measured from heat pulse propagation, agreed well with steady state power balance diffusivity in almost all of the FT operative space. Agreement was lost at low densities and high safety factors in both the FT and FTU machines. These results were consistent with a microinstability transport model.

27961 (ENEA-RT-NUCL–91-07, pp. 37-40) **Effect of ion bounce resonance on ideal and resistive MHD instabilities.** Romanelli, F.; Fogaccia, G.; Graziadei, S. ENEA, Frascati (Italy). Apr 1991. (CONF-9106293–Exc.: 18. European conference on controlled fusion and plasma heating, Berlin (Germany), 3-7 Jun 1991; RT/NUCL–91-07). In *Contributions to 18th conference on controlled fusion and plasma physics.* 40p. Order Number DE93799255. Source: OSTI; NTIS (US Sales Only); INIS.

The effect of parallel compressibility on the stability of the resistive ballooning mode and on the m = 1 internal kink mode in collisional regimes, appropriate to present day tokamak experiments, has recently been investigated. As resistive instabilities are described by a two spatial scale structure in toroidal geometry, the effect of compressibility can be defined either with reference to the short scale of the order of the connection length, qR, with q being the safety factor, and R, the major radius, or with reference to the long scale associated with the radial localization of the mode. This paper, including the ion bounce frequency effect, investigates the stability of resistive ballooning modes in the long mean free path regime, and discusses the effect of the transit and bounce resonances in the external region on the m = 1 internal kink mode. The latter contribution is shown to yield a stabilizing effect by increasing the high frequency fishbone mode threshold level.

27962 (ENEA-RT-NUCL–91-08) **Contributions to 20th international conference on phenomena in ionized gases.** ENEA, Frascati (Italy). Dipt. Fusione. Apr 1991. 19p. (CONF-910711–Exc.: 20. international conference on phenomena in ionized gases, Barga (Italy), 8-12 Jul 1991; RT/NUCL–91-08). Order Number DE93799235. Source: OSTI; NTIS (US Sales Only); INIS.

From the Contributions to the ENEA (Italian Agency for New Technology, Energy and the Environment) July 8-12, 1991 (Il Ciocco, Barga, Italy), XX International Conference on Phenomena in Ionized Gases, separate abstracts were prepared for 4 papers. The topics were: evolution of the electric field of ion Bernstein waves in tokamaks, properties of the ablation cloud surrounding solid hydrogen pellets injected into tokamaks, the Frascati Tokamak Upgrade Thomson scattering system, and the role of feedback in the evolution of double layers.

27963 (ENEA-RT-NUCL–91-08, pp. 5-9) **Evolution of electric field of ion Bernstein waves in tokamaks.** Cardinali, A.; Cesario, R.; De Marco, F. ENEA, Frascati (Italy). Apr 1991. (CONF-910711–Exc.: 20. international conference on phenomena in ionized gases, Barga (Italy), 8-12 Jul 1991; RT/NUCL–91-08). In *Contributions to 20th international conference on phenomena in ionized gases.* 19p. Order Number DE93799235. Source: OSTI; NTIS (US Sales Only); INIS.

Central ion heating by directly launched or mode converted Ion Bernstein Waves (IBW) has been extensively investigated in recent years. Experiments at low (100:500 kW) power levels have been successfully carried out on the Alcator C and PLT tokamaks. The experiment at a higher power level (1MW) on DIII-D showed a peripherical absorption of the wave and no significant central ion heating was observed. This negative result can probably be attributed to a bad coupling of the big Faraday-shielded coil antenna which was employed in the experiment. The IBW experiment which is planed on FTU (the Frascati Tokamak Upgrade) could avoid the disadvantages of an antenna coil placed inside the vacuum vessel by using a waveguide antenna for the coupling similar to the grill of the LH experiments. With a frequency of 433 MHz and a toroidal magnetic field of 80 kG, the 4th ion-cyclotron harmonic of hydrogen is placed near the plasma centre and the 5th is located outside the vacuum vessel. Two ways of exciting IBWs are expected for the experiment on FTU: the direct launch of IBW or the excitation of IBWs after mode transformation of an Electron Plasma Wave (EPW), which occurs in the edge plasma region near the cold Lower Hybrid Resonance (CLHR) layer. The first way will require operation with the antenna mouth located behind the CLHR layer and the second, with this layer in front of the antenna. In this present work, the characteristics of the IBW were studied mainly in the scrape-off plasma region where the mode-transformation is expected.

27964 (ENEA-RT-NUCL–91-08, pp. 15-16) **FTU Thompson scattering system.** Bartiromo, R.; Brusadin, A.; Giovannozzi, E.; Orsitto, F.; Santi, D.; Briccola, M.; Garbi, M.; Giorgetti, G.; Mezzetti, S.; Pizzolati, P. ENEA, Frascati (Italy); Centro Informazioni Studi Esperienze (CISE), Milan (Italy). Apr 1991. (CONF-910711–Exc.: 20. international conference on phenomena in ionized gases, Barga (Italy), 8-12 Jul 1991; RT/NUCL–91-08). In *Contributions to 20th international conference on phenomena in ionized gases.* 19p. Order Number DE93799235. Source: OSTI; NTIS (US Sales Only); INIS.

This paper provides some brief notes on the Thomson scattering system recently installed on the Frascati (Italy) Tokamak Upgrade (FTU). Information is also given on some of the FTU's key design and operating features and its diagnostics instrumentation. The Thomson scattering system is based on a Nd-Ylf laser delivering a burst of 10 pulses, 20 ns FWHM, 5 J per pulse at lambda = 1,053 nm. The laser beam is focussed into the plasma by a telescope (1,700 focal length) to a maximum diameter of 0.9 mm (for 90% of the energy) over a length of 40 cm. The time interval between pulses can be set independently to between 20 and 100 ms. The wavelength was chosen in the infrared range in order to have less plasma light and a better S/N ratio. The expected S/N ratio for Thomson scattering, at a plasma density of 3*10/sup13/per cubic centimeter and temperature of 3 keV, lies between 20 and 30 for the central channels, and about 10 for the edge channels. Consequently the calculated (delta T)/T values are, respectively, about 4 and 15%, and the calculated (delta n)/n values are 3 and 10%.

27965 (ENEA-RT-NUCL–91-08, pp. 17-19) **Role of feedback in evolution of double layers.** Condrea, I. ENEA, Frascati (Italy). Apr 1991. (CONF-910711–Exc.: 20. international conference on phenomena in ionized gases, Barga (Italy), 8-12 Jul 1991; RT/NUCL–91-08). In *Contributions to 20th international conference on phenomena in ionized gases.* 19p. Order Number DE93799235. Source: OSTI; NTIS (US Sales Only); INIS.

A model is proposed for the evolution of the double layer (DL) and for the generation of potential relaxation instability (PRI). Experimental results are used to develop an analogy between the formation, movement and disruption of the DL and an electronic circuit with feedback, as well as, with systems that have 'externally regulated-self-regulated' coupling. It is shown how the evolution of the DL can be described by a system of loops in which the character of the feedback changes. Based on this analogy, the DL can be regarded as a superior organized plasma structure (i.e., more complex and more organized). A similar analogy is presented for the PRI.

27966 (ENEA-RT-NUCL–91-21) **Effects of radial diffusion on triton burn up.** Batistoni, P.; Anderson, D.; Lisak, M. ENEA, Frascati (Italy). Dipt. Fusione; Chalmers Univ. of Technology, Goeteborg (Sweden). Inst. for Electromagnetic Field Theory and Plasma Physics. Nov 1991. 35p. (CONF-9106209–7: International Atomic Energy Agency (IAEA) technical committee meeting on alpha particles in fusion, Aspenas (Sweden), 10-14 Jun 1991; RT/NUCL–91-21). Order Number DE93799306. Source: OSTI; NTIS (US Sales Only); INIS.

A detailed investigation is made of the effect of finite confinement time and radial diffusion on the burn up of fusion produced 1 MeV tritons in hot deuterium plasmas. Explicit expressions are obtained for the concomitant reduction in total triton burn up and applications to JET and TFTR burn up measurements indicate diffusion constants D= 0.1-0.2m2/s for the fast tritons if the reduction is due to radial diffusion. The time dependence and the width of the emission profile of the 14 MeV neutrons from the triton burn up are also analyzed. Recent measurements of 14 MeV emission profiles on JET indicate a much smaller diffusion constant, viz. D 0.1 2m2/s. This implies that the observed finite confinement time of the tritons should not be due to radial diffusion and that the diffusion constant of the fast tritons should be very small.

27967 (ENEA-RT-NUCL–92-12, pp. 17-30) **Impurity screening in high density plasmas in tokamaks with limiter configuration.** Ferro, C.; Zanino, R. ENEA, Frascati (Italy); Politecnico di Torino, Turin (Italy). May 1992. (CONF-920311–Exc.: 10. international conference on plasma-surface interactions in controlled fusion devices, Monterey, CA (United States), 30 Mar - 3 apr 1992; RT/NUCL–92-12). In *Contributions to 10th international conference on plasma surface interactions.* 42p. Order Number DE93799249. Source: OSTI; NTIS (US Sales Only); INIS.

Impurity screening in high-density plasmas in tokamaks with a limiter configuration is investigated by means of a simple semi-analytical model. An iterative scheme is devised, in order to self-consistently determine the value of scrape-off layer thickness, edge electron density and temperature, and the main plasma contamination parameter, Z_{eff}, as a function of given average electron density and temperature in the main plasma and given input power. The model is applied to the poloidal limiter case of the Frascati Tokamak Upgrade, and the results are compared with experimental data. Reasonable agreement in the trends is found, emphasizing the importance of a high edge plasma density for obtaining a clean main plasma in limiter tokamaks.

27968 (ENEA-RT-NUCL–92-14) **Contributions to 1992 international conference on plasma physics.** ENEA, Frascati (Italy). Dipt. Fusione. May 1992. 40p. (CONF-920610–Exc.: ICPP 92: International conference on plasma physics, Innsbruck (Austria), 29 Jun - 3 jul 1992; RT/NUCL–92-14). Order Number DE93799278. Source: OSTI; NTIS (US Sales Only); INIS.

From the Contributions to the 1992 International Conference on Plasma Physics (Innsbruck, June 29 - July 3), separate abstracts were prepared for 9 papers. The topics included: the ion temperature gradient driven mode threshold; density limit and refuelling in FTU (Frascati Tokamak Upgrade) ohmic operation; FTU energy confinement; MHD equilibrium code for the ITER (International Thermonuclear Experimental Reactor) tokamak; FTU effective ion charge and impurity behaviour; FTU profile consistency and volt-second consumption; visible spectroscopic measurements; and alpha particle behaviour outside last closed magnetic surface in divertor stellarators.

27969 (ENEA-RT-NUCL–92-14, pp. 5-8) **Threshold of ion temperature gradient driven mode.** Guo, S.C.; Romanelli, F.; Rewoldt, G.; Tang, W.M. ENEA, Frascati (Italy); Princeton Univ., NJ (United States). Plasma Physics Lab. May 1992. (CONF-920610–Exc.: ICPP 92: International conference on plasma physics, Innsbruck (Austria), 29 Jun - 3 jul 1992; RT/NUCL–92-14). In *Contributions to 1992 international conference on plasma physics.* 40p. Order Number DE93799278. Source: OSTI; NTIS (US Sales Only); INIS.

The ion temperature gradient driven mode is believed to play a major role in affecting energy transport in tokamak devices. The relative mode dynamics near threshold are affected by several kinetic effects. This paper gives a unified picture of the ion temperature gradient driven mode dynamics through the use of model differential equations and general explicit expressions for the threshold which are valid in the entire parameter range of interest. It is found that the results agree very well with those obtained with the use of the numerical solutions of the full kinetic integral equation. The stability analysis is separated into two parts - short and long wavelength limits. The assumptions of a pure plasma with circular shape and low beta equilibrium are used along with the electrostatic equation. Nevertheless, the range of validity of the results covers the whole collisionality domain of interest, long and short wavelengths, and moderately low and finite shear, and peaked and flat density profiles. In addition, the study fully accounts for the effects related to toroidal geometry.

27970 (ENEA-RT-NUCL–92-14, pp. 9-12) **Density limit and refuelling in FTU ohmic operation.** Frigione, D.; Tonini, G. ENEA, Frascati (Italy). May 1992. (CONF-920610–Exc.: ICPP 92: International conference on plasma physics, Innsbruck (Austria), 29 Jun - 3 jul 1992; RT/NUCL–92-14). In *Contributions to 1992 international conference on plasma physics.* 40p. Order Number DE93799278. Source: OSTI; NTIS (US Sales Only); INIS.

The Frascati Tokamak Upgrade (FTU) device (R=0.93 m; a=0.3 m; toroidal field = 8 T; toroidal current = < 1.6 MA) has been operating during the last two years in the ohmic regime with H_2, D_2 and He filling gases. Most of the H_2 and D_2 data, if plotted in the traditional Hugill plot, show a q-independent density limit, corresponding to $nR/B=2.3x10^{19}$ Wb^{-1}. This reproduces the FT density limit at a safety factor (q)=6.7, while is a factor of 2 lower at q=3.3; at this value, the FT limit has been fully recovered in He. Peaked density profile discharges have a higher nRq/B parameter, thus supporting the idea that the limiting density is that of the edge.

27971 (ENEA-RT-NUCL–92-14, pp. 17-20) **Application of reconstructive MHD code based on formalism of toroidal multipoles to iter tokamak.** Alladio, F.; Lalousis, P.; Micozzi, P. ENEA, Frascati (Italy). May 1992. (CONF-920610–Exc.: ICPP 92: International conference on plasma physics, Innsbruck (Austria), 29 Jun - 3 jul 1992; RT/NUCL–92-14). In *Contributions to 1992 international conference on plasma physics.* 40p. Order Number DE93799278. Source: OSTI; NTIS (US Sales Only); INIS.

One of the most important diagnostic techniques for current and future tokamak experiments aimed at thermonuclear ignition is MHD equilibrium simulation based on data from magnetic probes measuring magnetic fields and fluxes on a contour enclosing the plasma column. The aim of this paper is to generalize the ODIN equilibrium code so as to obtain the capability of: treating any possible magnetic probe set; quickly identifying plasma boundary characteristics; obtaining global plasma quantities, as well as, information on local equilibrium quantities such as safety factor and toroidal current density profiles. In order to simulate equilibria relative to the ITER (International Thermonuclear Experimental Reactor) tokamak, the ODIN code (incorporating the Grad-Shafranov equation) was interfaced with the finite element prediction code, PROTEUS, which determines the values of the fluxes and magnetic fields at the probe positions for current ITER reference scenarios.

27972 (ENEA-RT-NUCL–92-14, pp. 21-24) **Effective ion charge and impurity behavior in Frascati tokamak upgrade.** McNeill, D.H.; Zanza, V.; Mazzitelli, G.; Bracco, G.; Condrea, I.; De Angelis, R.; Orsitto, F.; Panaccione, L.; Segre, S. ENEA, Frascati (Italy). May 1992. (CONF-920610–Exc.: ICPP 92: International conference on plasma physics, Innsbruck (Austria), 29 Jun - 3 jul 1992; RT/NUCL–92-14). In *Contributions to 1992 international conference on plasma physics.* 40p. Order Number DE93799278. Source: OSTI; NTIS (US Sales Only); INIS.

The effective ion charge, Zeff, is an important measure of plasma purity in tokamak discharges. In the Frascati Tokamak Upgrade (FTU), diametral average values of Zeff, obtained from visible bremsstrahlung and from the Spitzer plasma resistivity for ohmically heated discharges, are generally in good agreement. This paper discusses the two types of measurements and relates the behaviour of Zeff to the impurities in the plasma. The major object of study on the FTU is high density plasmas with high heat loads on the limiters. Understanding the variation of Zeff with time and density in FTU plasmas involves questions of plasma initiation and fuelling, as well as, transport. This paper limits the examination of this topic to a brief review of the relationships between Zeff and the impurities observed by visible and UV spectroscopy. The main light impurity now observed in the FTU is oxygen, while nickel and chromium are the major heavy impurities. Oxygen is desorbed from the walls, while the metallic impurities are produced by sputtering, from (mostly) the limiter. In general, the influx of metallic impurities into a discharge decreases as the electron density rises and, depending on the plasma current, almost disappears at the maximum density attained in ohmic discharges. Systematic changes in the impurity influxes over the early operating period of the FTU have been mirrored in a gradual decline of Zeff.

27973 (ENEA-RT-NUCL–92-14, pp. 25-28) **Profile consistency on FTU.** Buratti, P.; Zerbini, M.; Bracco, G.; Segre, S.E.; Zanza, V. ENEA, Frascati (Italy). May 1992. (CONF-920610–Exc.: ICPP 92: International conference on plasma physics, Innsbruck (Austria), 29 Jun - 3 jul 1992; RT/NUCL–92-14). In *Contributions to 1992 international conference on plasma physics.* 40p. Order Number DE93799278. Source: OSTI; NTIS (US Sales Only); INIS.

The analysis of several tokamak experiments revealed that the electron temperature profile shape is not influenced by plasma parameters such as current, density and magnetic field, except for a dependence on the edge safety factor, q_a, for $r/a<0.6$. Both this dependence and the law governing the peaking factor can be explained as effects of sawtooth instability that keeps the central q close to one. This paper presents the first observations on the shape of the electron temperature profile on the FTU (Frascati Tokamak Upgrade) tokamak (major radius, 0.935 m; limiter radius, 0.3 m; magnetic field, B<8 T).

27974 (ENEA-RT-NUCL–92-14, pp. 29-32) **Volt-second consumption and current ramp experiments on FTU.** Apruzzese, G.; Crisanti, F.; Frigione, D.; Kroegler, H.; Lovisetto, L.; Mazzitelli, G.; Podda, S.; Buratti, P.; Zerbini, M.; Romanelli, F. ENEA, Frascati (Italy). May 1992. (CONF-920610–Exc.: ICPP 92: International conference on plasma physics, Innsbruck (Austria), 29 Jun - 3 jul 1992; RT/NUCL–92-14). In *Contributions to 1992 international conference on plasma physics.* 40p. Order Number DE93799278. Source: OSTI; NTIS (US Sales Only); INIS.

The volt-second consumption in the Frascati Tokamak Upgrade (FTU) was evaluated both during plasma start-up and current ramp-up from one flat top level to a higher flat top level. The Poynting definition was used to work out the resistive volt-second consumption; the equilibrium reconstruction ODIN code was used to get the necessary physical quantities. The Ejima parameter was evaluated for a large set of shots in hydrogen, deuterium and helium. Current ramp-down experiments were performed on the FTU at rates up to 9 MA/s, in order to study current diffusion with transiently decoupled current and electron temperature profiles. As the current profile is not directly measured in the FTU, its evolution was calculated by the JETTO code and the resulting plasma internal inductance was compared to the measured one. This paper presents and discusses the the results of FTU shot 3322 in which the current varied from 500 to 280 kA in 40 ms at a rate of 5.5 MA/s, about six times faster than the L/R decay rate. No evidence of anomalous current diffusion was found. Given experimental uncertainties, simulations assuming Spitzer resistivity agree with measured data both taking into account and neglecting trapped particle corrections.

27975 (ENEA-RT-NUCL–92-14, pp. 33-36) **Visible spectroscopic measurements on FTU.** Condrea, I.; Bartiromo, R.; Mazzitelli, G.; McNeill, D.H. ENEA, Frascati (Italy). May 1992. (CONF-920610–Exc.: ICPP 92: International conference on plasma physics, Innsbruck (Austria), 29 Jun - 3 jul 1992; RT/NUCL–92-14). In *Contributions to 1992 international conference on plasma physics.* 40p. Order Number DE93799278. Source: OSTI; NTIS (US Sales Only); INIS.

Visible spectroscopy has been extensively used on the FTU (Frascati Tokamak Upgrade) to measure the intensity of the spectral lines of hydrogen, light impurities (C,O,N) and metallic impurities (Ni, Cr, Fe). The plasma light was collected along selected tangential and radial chord views in order to observe the vacuum chamber wall and the limiter respectively. The visible light emitted by atoms and ions was collected by a telescope and focused onto one end of a 1mm diameter optics fiber. The other end of this quartz fiber (f/3) was directly attached onto the entrance slit of a Monospec 27 grating spectrometer (f/3.8) and equipped at the exit slit with an intensified linear diode array. The spectrometer can use 3 different gratings in order to have linear dispersions of 3, 6 and 24 nm/mm. The second and the gratings were used in the FTU experiments to cover a spectral range of 3000 A and 700 A respectively. The spectrometer was calibrated in absolute intensity using a calibrated lamp and a lambertian diffuser. The impurity influx was derived from the absolute line intensity through the calculated value of ionization to photon emission ratio.

27976 (ENEA-RT-NUCL–92-17) **Resistive toroidal stability of internal kink modes in circular and shaped tokamaks.** Vlad, G.; Bodenson, A.; Lutjens, H. ENEA, Frascati (Italy). Dipt. Fusione; Ecole Polytechnique Federale, Lausanne (Switzerland). Centre de Recherches en Physique des Plasmas. Jul 1992. 34p. (RT/NUCL–92-17). Order Number DE93799305. Source: OSTI; NTIS (US Sales Only); INIS.

The linear resistive magnetohydrodynamic (MHD) stability of the internal kink mode in tokamaks is studied by toroidal computations. The stabilizing influence of the small aspect ratio is confirmed, but it is found that shaping of the cross section influences the internal kink stability significantly. For finite pres sure and small resistivity, curvature effects at the q=1 surface give rise to asensitive dependence on shape; and ellipticity (including JET shape) is destabilizing. Only a very restricted set of finite pressure equilibria is completely stable for $q0<1$. A typical result is that the resistive kink mode is slowed down by toroidal effects to a weak tearing/ resistive interchange mode. It is suggested that weak resistive instabilities are stabilized during the ramp phase of teeth by effects not included in the linear resistive MHD model. Possible mechanisms for triggering a sawtooth crash are discussed.

27977 (ENEA-RT-NUCL–92-22) **Ion Bernstein wave propagation and absorption in general magnetic field configuration.** Cardinali, A.; Riccardi, C. ENEA, Frascati (Italy); Milan Univ. (Italy). Dipt. di Fisica. Dec 1992. 15p. (RT/NUCL–92-22). Order Number DE93799265. Source: OSTI; NTIS (US Sales Only); INIS.

A linear analysis of the Ion Bernstein Waves (IBW) propagation and absorption is presented by considering a general tokamak plasma magnetic equilibrium. The effects of elongation, triangularity and Shafranov-shift on the rf absorption is discussed with respect to the simple case of circular and concentric magnetic surfaces. The ray-tracing equations are analytically and numerically solved in the flux surface coordinate system and the power deposited into the plasma is calculated along the trajectory. It is found that the absorption of the wave results strongly affected by the geometry of the magnetic surfaces. Whereas the Shafranov shift does not produce any relevant effects on the wave damping at least for $beta_{pol}=O(1)$, high elongated plasmas act in reducing the peripheral electron absorption and allow the penetration of the wave at the resonance layer. High triangularity, on the contrary, induces a strong electron absorption localized in the plasma periphery.

27978 (ETDE-IT–93-159) **Stability analysis of ion temperature gradient mode in non-circular tokamak geometry.** Guo, S.C.; Romanelli, F. ENEA, Frascati (Italy). 1992. 7p. (CONF-920813–4: Joint Varenna-Lausanne international workshop on theory of fusion plasmas, Varenna (Italy), 24-28 Aug 1992). Order Number DE93799229. Source: OSTI; NTIS (US Sales Only); INIS.

This paper studies the tokamak shaping effects on the ion temperature gradient modes in the long wave length limit (poloidal wave number^2 ion Larmor radius^2 << epsilon T^{1-2}). A model equilibrium with non circular cross section is employed, where the elongation, the Shafranov shift and the triangularity are all taken into account. It was shown that when the value of the poloidal wave number is lower than epsilon T^{1-4}-ion Larmor radius, the ion temperature gradient modes have a broad structure, and two branches exist. One of them is characterized by a variation along the equilibrium magnetic field dominated by the secular scale, with superimposed small oscillations on the connection length scale. This is the so called slablike branch. The effects of the normal curvature in this branch tend to be averaged out while the geodesic curvature simply yields a renormalization of the inertia term through the Pfirsch-Schluter enhancement factor. The other branch, peculiar to toroidal geometry, is the so called toroidicity induced branch, characterized by eigenfunctions varying over the connection-length scale with their envelop varying over the secular scale. In this paper, it is shown that in addition to this toroidal branch, the non-circular effects can induce new unstable branches.

27979 (ETDE-IT–93-163) **Comments on article 'Enhanced carbon influx into TFTR supershots', by A.T. Ramsey et al., Nuclear Fusion 31, 1811-1825 (1991).** McNeill, D.H. ENEA, Frascati (Italy). 1992. 5p. Order Number DE93799233. Source: OSTI; NTIS (US Sales Only); INIS.

In their article Ramsey et al. relate the development of 'carbon blooms' and the deterioration of confinement in high-power discharges in TFTR to increases in the light detected at 6578 A (corresponding to line emission of the C+ ion), 4649 A (C++), 6563-6561 A (H and D alpha), and 5235 A (bremsstrahlung continuum). In particular, the temperatures of localized hot regions on the limiter are correlated to emission at these wavelengths in an attempt to determine threshold temperatures for radiation enhanced sublimation (RES) and thermal sublimation. They have, however, omitted the contribution to their intensity data from the thermal

emission of incandescent regions of the limiter. This oversight will lead to errors in the interpretation of data on the onset of RES because the visible black body radiation reaching the detectors can form a large part of the observed signal levels. Since no spectrum line profiles have been provided, we cannot know what fraction of the reported visible intensities actually come from the plasma. The following discussion shows that a strong continuum signal from thermal radiation of incandescent surfaces must be present in at least some of the reported measurements. This analysis does not exclude further contributions from small (diameter <1 mm), dense plasmas on the limiter of the type that might be produced, for example, in unipolar arcs as the plasma comes close to the limiter.

27980 (ETDE-IT–93-167) **Gyrokinetic particle simulation using delta F-bar algorithm.** Briguglio, S.; Romanelli, F.; Betello, G. ENEA, Frascati (Italy). 1992. 10p. (CONF-9206381–1: Technical committee meeting on advances in simulation and modelling of thermonuclear plasmas, Varennes (Canada), 15-17 Jun 1992). Order Number DE93799244. Source: OSTI; NTIS (US Sales Only); INIS.

Ion temperature gradient driven modes are generally considered as possible candidates to explain anomalous transport in tokamaks. Quasi-linear estimates of the transport coefficients, based on mixing length arguments yield a fairly qualitative agreement with the parametric dependence of experimental data; but the quantitative agreement seems to be too rough. Recently, fluid code simulations of the ion temperature gradient driven mode turbulence have shown that a strong thermal ion flux reduction, correlated with the formation of large scale coherent structures, can occur. It is relevant to investigate how these phenomena are affected by the inclusion of kinetic effects such as finite ion Larmor radius effects and wave particle resonances. Gyrokinetic particle simulations of the ion temperature gradient driven mode turbulence are suited to address this point because they evolve model equations which include kinetic mechanisms, but still retain the effect of the gyromotion in the average sense, thus allowing for larger simulation time-step and grid-spacing. This paper aims to point out some of the problems concerning particle distribution loading in gyrokinetic simulations, and to discuss the advantages of adopting the so-called delta F-bar algorithm to properly solve these problems. Some preliminary results related to ion-flux reduction and coherent-structure occurence are also presented.

27981 (ETDE-IT–93-168) **Propagation and absorption of electromagnetic waves in collisional, partially ionised gases.** De Marco, F. ENEA, Frascati (Italy). 1992. 18p. (CONF-9209189–3: Industrial applications of plasma physics workshop, Varenna (Italy), 2-12 Sep 1992). Order Number DE93799248. Source: OSTI; NTIS (US Sales Only); INIS.

This paper first briefly reviews the principal collision processes occurring in the outer boundary of tokamak plasmas in which case the effects of collisions of charged particles with neutrals and with themselves in phenomena such as wave propagation must be taken into account. Practical expressions are developed for cross sections and collision frequencies. The paper then considers propagation and absorption of microwaves or other electromagnetic waves injected into tokamak plasma. The plasma is described with a fluid model and, in the moment balance equation, a momentum damping term, proportional to the product of collision frequency and the velocity vector, is included to account for collisional effects. A plane wave approach in an infinite homogeneous medium is used for the simplification of the analysis. Finally, brief comments are made on the possibilities and limitations of particle wave resonances.

27982 (ETDE-IT–93-171) **Linear and nonlinear stability of toroidal Alfven eigenmodes.** Vlad, G.; Briguglio, S.; Kar, C.; Zonca, F.; Romanelli, F. ENEA, Frascati (Italy). Sep 1992. 22p. (CONF-920813–5: Joint Varenna-Lausanne international workshop on theory of fusion plasmas, Varenna (Italy), 24-28 Aug 1992). Order Number DE93799253. Source: OSTI; NTIS (US Sales Only); INIS.

In the gaps of the continuum Alfven spectrum discrete, global modes induced by toroidicity (the so called Toroidal Alfven Eigenmodes or TAE) have been shown to exist. These modes can be destabilized by the resonant interaction with the parallel motion of the energetic ions, as alpha particles produced in fusion reactions. The TAE stability is determined by the competition between such a driving mechanism and the coupling with the Alfven continuum which provides a damping. The numerical study of the effect of high energetic particles on MHD modes requires the solution of the fluid equations for the bulk plasma and of the kinetic equations for the energetic particles (from which the name, hybrid codes, is derived). In this paper, the hybrid code will be described. Detailed results of the dynamics of the Alfven continuum, a primary importance issue for a correct description of the mode damping, will be given. Here we focus on the Toroidal Alfven Eigenmode dynamics in the absence of energetic particles with particular emphasis to the dependence of the damping rate on resistivity and on the interaction with Alfven continuum. An analytical model for the TAE nonlinear saturation, based on a three mode coupling truncated scheme of the MHD equations, is also presented.

27983 (ETDE-IT–93-172) **Kinetic theory of fishbone mode.** Fogaccia, G.; Romanelli, F. ENEA, Frascati (Italy). Sep 1992. 9p. (CONF-920813–6: Joint Varenna-Lausanne international workshop on theory of fusion plasmas, Varenna (Italy), 24-28 Aug 1992). Order Number DE93799254. Source: OSTI; NTIS (US Sales Only); INIS.

A population of energetic trapped particles can play a destabilizing role on the internal kink mode and excite a high frequency mode (fishbone mode) by a resonant interaction with the magnetic drift frequency of the hot ions. Parallel compressibility effects are not properly accounted for by the MHD model. If the fishbone mode frequency is comparable with the ion transit frequency, parallel compressibility effects become important and a kinetic description is necessary for the thermal ions. Transit and bounce resonance effects in the inertial layer have been considered in previous publications, while the extension of such analysis to the external region, is considered in this work. In addition, the non-resonant effects are also discussed. The aim of the work is to characterize the region of parameter space which is stable against the internal kink and fishbone modes.

27984 (ETDE-IT–93-181) **Model for linear and non-linear stages of 2-D Rayleigh-Taylor instability.** Wouchuk, J.G. ENEA, Frascati (Italy). 1993. 23p. Order Number DE93799268. Source: OSTI; NTIS (US Sales Only); INIS.

Relevant to studies on the acceleration and stagnation phases of inertial confinement fusion targets, a new model is developed which describes the evolution of the 2-D Rayleigh-Taylor instability by evaluating the rate of change of the vorticity generated at the unstable interface. For single mode perturbations, the known results for the linear growth rate and for the asymptotic bubble velocity are recovered. The stabilizing effect of mass ablation is also evidenced. In the case of multi-mode perturbations, the model predicts growth of the highest rising bubbles in agreement with recent experiments and numerical simulations.

27985 (ETDE-IT–93-182) **Possibility of achieving very good confinement in compact high-field tokamaks.** Segre, S.E.; Zanza, V. ENEA, Frascati (Italy). 1993. 10p. Order Number DE93799270. Source: OSTI; NTIS (US Sales Only); INIS.

Compact high-field tokamaks have operated only at relatively low values of beta. The recovery in such devices of values of beta typical of low-field tokamaks would be important. In a recent analysis the thermal energy content of a wide range of tokamaks was successfully reproduced by using only the momentum and particle balance equations. Extending here the analysis to possible future experiments, it is found that, by using low energy neutral beam injection, it may be possible, in high-field tokamaks, to achieve relatively high values of beta with a low power expenditure and, therefore, a large confinement time.

27986 (ETDE-IT–93-183) **Simultaneous measurement by polarimetry of both electron line density and poloidal magnetic field in tokamaks.** Segre, S.E. ENEA, Frascati (Italy). 1993. 17p. Order Number DE93799271. Source: OSTI; NTIS (US Sales Only); INIS.

It is shown how one can measure at the same time both the electron line density and the poloidal magnetic field in a tokamak,

using only a polarimeter in order to determine the full state of polarization of radiation transmitted across the plasma. The proposed polarimeter is simpler and more flexible than the more conventional interferometer/polarimeter used at present on various tokamaks.

27987 (ETDE-IT–93-188) **Fast electron confinement during lower hybrid experiments in Asdex.** Bartiromo, R.; Barbato, E.; Gabellieri, L.; Spaziani, A.; Tuccillo, A.A. ENEA, Frascati (Italy); Max-Planck-Institut fuer Plasmaphysik, Garching (Germany). 1992. 29p. Order Number DE93799275. Source: OSTI; NTIS (US Sales Only); INIS.

This paper presents a detailed analysis of experimental data on the energy content in the fast electron population created by lower hybrid waves in the Asdex tokamak and shows that, in most circumstances, direct losses due to diffusion of these electrons can be neglected. The value of the diffusion coefficient of fast electrons is inferred from the time behaviour of hard X- ray emission during power modulation experiments. It turns out that fast electrons are better confined than the thermal ones. This experimental result is compared with predictions of theories based on transport driven by electrostatic or magnetic turbulence.

27988 (ETDE-IT–93-189) **Analytic expression for influence of plasma birefringence on Faraday rotation measurements in tokamak plasma.** Segre, S.E.; Nowak, S. ENEA, Frascati (Italy). 1992. 16p. Order Number DE93799276. Source: OSTI; NTIS (US Sales Only); INIS.

An approximate analytic expression is given for the influence of plasma birefringence on Faraday rotation in tokamaks and the range of validity is determined. The expression is of interest for polarimetric measurements and for the analysis of electron cyclotron emission.

27989 (EUR-CEA-FC–1471) **Transport in a fusion plasma in presence of a chaotic magnetic field.** Nguyen, F. Association Euratom-CEA, Centre d'Etudes de Cadarache, 13 - Saint-Paul-lez-Durance (France). Dept. de Recherches sur la Fusion Controlee; Paris-7 Univ., 75 (France). Sep 1992. [216p.] (In French). Source: OSTI; NTIS (US Sales Only); INIS.

In the tokamak Tore Supra, the magnetic field ensuring the confinement is stochastic at the plasma edge due to a resonant perturbation. This perturbation is created by a set of six helicoidal coils inside the vacuum vessel, the ergodic divertor. The first part of the study concerns the analysis of the transport of particles and energy in a fusion plasma in presence of a stochastic magnetic field, without physical wall. The effective transport of electrons, i.e. heat transport, increases. The ions transport increases too but less than heat transport. The discrepancy produces a mean radial electric field. The second part is devoted to the influence of the physical wall. The topology of the magnetic connexion on the wall is precisely determined with the code Mastoc. The transport of particles and energy is then described from the confined plasma until the wall. This study enlights severals important observations of the experience Tore Supra in the ergodic divertor configuration: the spreading of the power deposition on the wall components without anomalous concentration, the robustness of this configuration relatively to misalignment, the edge structures visible in H_α light during plasma reattachment. In order to study the transport of impurity ions, a variational approach of minimum entropy production has been developped. This principle is applied to the calculation of the neoclassical diffusion of impurity ions with the radial electric field. This electric field deconfines ions if the pressure profile is not balanced by a Lorentz force, i.e. if the plasma is locked in rotation, poloidally and toroidally, because of magnetic perturbation or friction force.

27990 (GA-A–21257) **Dimensionally similar discharges with central rf heating on the DIII-D tokamak.** Petty, C.C.; Luce, T.C.; Pinsker, R.I. General Atomics, San Diego, CA (United States). Apr 1993. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-89ER51114. (CONF-9304112–11: 10. topical conference on radio frequency power in plasmas, Boston, MA (United States), 1-3 Apr 1993). Order Number DE93012776. Source: OSTI; NTIS; INIS; GPO Dep.

The scaling of L-mode heat transport with normalized gyroradius is investigated on the DIII-D tokamak using central rf heating. A toroidal field scan of dimensionally similar discharges with central ECH and/or fast wave heating show gyro-Bohm-like scaling both globally and locally. The main difference between these restats and those using NBI heating on DIII-D is that with rf heating the deposition profile is not very sensitive to the plasma density. Therefore central heating can be utilized for both the low-B and high-B discharges, whereas for NBI the power deposition is decidedly off-axis for the high-B discharge (i.e., high density).

27991 (GA-A–21292) **Modification of electrical conductivity in T-10 by electron cyclotron heating.** Harvey, R.W.; Forest, C.B.; Sauter, O.; Lohr, J.; Lin-Liu, Y.R. General Atomics, San Diego, CA (United States). Apr 1993. 4p. Sponsored by USDOE, Washington, DC (United States); Swiss National Science Foundation, Bern (Switzerland). DOE Contract AC03-89ER51114. (CONF-9304112–14: 10. topical conference on radio frequency power in plasmas, Boston, MA (United States), 1-3 Apr 1993). Order Number DE93014313. Source: OSTI; NTIS; INIS; GPO Dep.

The CQL3D Fokker-Planck code is used to investigate effects of quasilinear distortion of the electron tail in the T-10 second harmonic electron cyclotron current (ECCD) drive experiment. The experiment operates in a regime of substantial tail formation. Current drive efficiency may be doubled relative to low power cases, That portion of electric field-driven current which is synergetic with the rf-induced nonthermal tail may tend to cancel the ECCD current in relevant cases.

27992 (GA-A–21301) **Beta-limiting instabilities in DIII-D discharges with large bootstrap current.** Strait, E.J.; Taylor, T.S.; Turnbull, A.D.; Chu, M.S.; Ferron, J.R.; Lao, L.L.; Osborne, T.H. General Atomics, San Diego, CA (United States). May 1993. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-89ER51114. (CONF-930720–10: 20. European conference on controlled fusion and plasma physics, Lisbon (Portugal), 26-30 Jul 1993). Order Number DE93015476. Source: OSTI; NTIS; INIS; GPO Dep.

Short communication. DOUBLET-3 DEVICE/kink instability; BOOTSTRAP CURRENT; EDGE LOCALIZED MODES; MHD EQUILIBRIUM; H-MODE PLASMA CONFINEMENT

27993 (GA-A–21304) **Active density control in DIII-D H-mode plasmas.** Mahdavi, M.A. (General Atomics, San Diego, CA (United States)); Schaffer, M.J.; Anderson, P.M.; Baxi, C.B.; Brooks, N.H.; Burrell, K.H.; Campbell, G.L.; deGrassie, J.S.; Evans, T.E.; Ferron, J.R.; Groebner, R.J.; Hinton, F.L.; Hollerbach, M.A.; Hyatt, A.W.General Atomics, San Diego, CA (United States); Lawrence Livermore National Lab., CA (United States); Sandia National Labs., Albuquerque, NM (United States); Oak Ridge National Lab., TN (United States); California Univ., Los Angeles, CA (United States). May 1993. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-89ER51114 ;W-7405-ENG-48 ;AC04-76DP00789 ;AC05-84OR21400 ;FG03-89ER51121. (CONF-930720–9: 20. European conference on controlled fusion and plasma physics, Lisbon (Portugal), 26-30 Jul 1993). Order Number DE93015477. Source: OSTI; NTIS; INIS; GPO Dep.

In this paper we present the first results of divertor cryopumping experiments in the absence of biasing on DIII-D H-mode plasmas.

27994 (GA-A–21306) **Dependence of $\beta \cdot \tau$ on plasma shape in DIII-D.** Lazarus, E.A. (Oak Ridge National Lab., TN (United States)). General Atomics, San Diego, CA (United States). May 1993. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-89ER51114 ;AC05-84OR21400. (CONF-930720–6: 20. European conference on controlled fusion and plasma physics, Lisbon (Portugal), 26-30 Jul 1993). Order Number DE93015473. Source: OSTI; NTIS; INIS; GPO Dep.

In this paper we discuss the observed variation in plasma performance with plasma shape, in particular, we shall compare single and double null diverted plasmas. The product $\beta \cdot \tau$ has been used as a figure-of-merit for comparing different toroidal magnetic configurations. Here we shall use it as the figure-of-merit for comparing differing configurations within the DIII-D tokamak.

27995 (GA-A–21308) **The role of electric field shear stabilization of turbulence in the H-mode to VH-mode transition in DIII-D.** Burrell, K.H. (General Atomics, San Diego, CA (United

States)); Osborne, T.H.; Groebner, R.J.; Rettig, C.L. General Atomics, San Diego, CA (United States). May 1993. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-89ER51114. (CONF-930720–7: 20. European conference on controlled fusion and plasma physics, Lisbon (Portugal), 26-30 Jul 1993). Order Number DE93015474. Source: OSTI; NTIS; INIS; GPO Dep.

Short communication. TURBULENCE/stabilization; H-MODE PLASMA CONFINEMENT/turbulence; DOUBLET-3 DEVICE; ELECTRIC FIELDS; SHEAR; TURBULENCE; STABILIZATION; ION TEMPERATURE; TIME DEPENDENCE; CONFINEMENT TIME; MOMENTUM TRANSFER

27996 (GA-A–21316) **Measurements of edge fluctuations by phase contrast imaging on DIII-D.** Coda, S. (Massachusetts Inst. of Tech., Cambridge, MA (United States)); Porkolab, M.; Burrell, K.H.; Carlstrom, T.N. General Atomics, San Diego, CA (United States). May 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-89ER51114 ;FG02-91ER54109. (CONF-930720–5: 20. European conference on controlled fusion and plasma physics, Lisbon (Portugal), 26-30 Jul 1993). Order Number DE93014018. Source: OSTI; NTIS; INIS; GPO Dep.

A novel imaging diagnostic for the investigation of edge plasma density fluctuations was recently installed on the DIII-D tokamak. The diagnostic, which is based on the Zernike phase contrast method, was developed in response to the need for spatially resolved, long wavelength fluctuation measurements. Unique features of this system include: Large bandwidth (100 MHz), high sensitivity ($\tilde{n}_e \simeq 10^9$ cm^{-3}), and absolute calibration capability. Initial results are presented on the fluctuation suppression at the L- to H-mode transition and on the bursts of turbulent activity which occur during ELMs.

27997 (IC–93/89) **Resonant absorption of Alfven waves near a neutral point.** Uberoi, C. International Centre for Theoretical Physics, Trieste (Italy). May 1993. [10p.] Order Number DE93628761. Source: OSTI; NTIS (US Sales Only); INIS.

The resonant absorption of Alfven waves at the neutral point is discussed by using the existing mathematical theories of the Alfven wave equation both for ideal and resistive plasmas. It is found that in the case of ideal system the resonant phenomena of Alfven waves does not show any different behaviour near a finite or a zero singular point. In case of resistive plasma initially the evolution of the system in time proceeds without any difference from the ideal system till time $t \leq t_n$. When $t > t_n$, the high frequency surface waves are resonantly mode converted to the resistivity modified shear Alfven wave at non-zero singular points but at the neutral point the zero-frequency surface waves which are symmetrical surface modes of the structured neutral layer couple to the tearing mode of instability of the layer. The importance of this study to the energy balance in tearing modes and the association of surface waves to driven magnetic reconnection is also pointed out. (author). 11 refs.

27998 (INIS-mf–13545, pp. 122-128) **Cold fusion observation at gas-discharge device cathode.** Karabut, A.B. (Scientific Industrial Assocation "Lutch", Podolsk (Russian Federation)); Kucherov, Ya.R.; Savvatimova, I.B. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 6.* [218p.] Order Number DE93630454. Source: OSTI; NTIS (US Sales Only); INIS.

The experimental results on cold fusion observation at glow discharge in deuterium are presented. Neutron fluxes up to 10^7 n/s were registered with various experimental methods (He_3-filled neutron detectors and by activation of silver foil). Heat release exceeding input electric energy by 20-50% was measured with a dynamic calorimeter. The heat surplus exceeds possible chemical reactions heat release in discharge chamber volume. The heat flow correlates with neutron flux magnitude. 3 refs.; 5 figs. (author).

27999 (IPPCZ–324) **Dynamic behaviour of an electric arc gas discharge.** Jenista, J. Ceskoslovenska Akademie Ved, Prague (Czech Republic). Ustav Fyziky Plazmatu. Aug 1992. [30p.] Order Number DE93630197. Source: OSTI; NTIS (US Sales Only); INIS.

The time-dependent energy and circuit equations are solved numerically to obtain temperature profiles, current-voltage characteristics and electric field strength vs axial temperature diagrams in the asymptotic region of a wall-stabilized electric arc operated in nitrogen. Dynamic current-voltage characteristics and transient phenomena of steady state formation during the spark ignition phase are studied. The arc time-constant for free decay is computed and compared with approximate analytical results. It is found that for fixed initial conditions, the arc response to the variable applied voltage is several times longer than the arc time-constant for free decay. (author) 4 figs., 11 refs.

28000 (IYaF–92-8) **Bulk plasma heating by a microsecond E-beam in the GOL-3 facility.** Burdakov, A.V. (and others); Voropaev, S.G.; Guber, A.F. AN SSSR, Novosibirsk (Russian Federation). Inst. Yademoj Fiziki. 1992. [27p.] (In Russian). Order Number DE93630186. Source: OSTI; NTIS (US Sales Only); INIS.

Experimental results on a 10^{15}cm^{-3} plasma heating by a microsecond electron beam at the GOL-3 device are presented. The beam of 100 kJ energy content was injected in the hydrogen plasma placed inside a 7-m-long solenoid with 5.5 T magnetic field. The experiments were emphasized on the studies of the bulk plasma heating by means of laser scattering technique and on the beam energy spectrum analysis after its passing the plasma. The decay of the plasma temperature after the beam injection and is discussed. 19 refs.; 16 figs.

28001 (JET-R–92-12) **Specification of a helium atom beam required for neutral particle analyzer and for charge exchange resonance spectroscopy applications in JET.** Gondhalekar, A. Commission of the European Communities, Abingdon (UK). JET Joint Undertaking. Nov 1992. [19p.] Order Number DE93630187. Source: OSTI; NTIS (US Sales Only); INIS.

An important concern in Deuterium-Tritium fusion α-particle heating physics in tokamak configuration is that the 3.5MeV ions will be lost before giving up all their energy to heat the plasma, in other words that the radial diffusion time of α-particles will be shorter than their slowing-down time in the plasma core, thus reducing effectiveness of α-particle heating. Spatially resolved measurements of slowing-down and radial transport of α-particles and other MeV energy ions in the plasma is a high priority diagnostic objective in the Joint European Torus Project (JET). To this end three experiments are in preparation at JET, a high energy Neutral Particle Analyzer (NPA) capable of measurement of α-particles of energy $0.5 \leq E_\alpha$ (MeV) ≤ 3.5, a Charge-Exchange Resonance Spectroscopy (CXRS) measurement, and a μ-wave scattering measurement. The NPA application utilizes a double charge-exchange (CX) reaction between an α-particle and a helium atom present in the plasma, while the CXRS relies on a single CX reaction with a hydrogenic or helium atom. The donor atoms needed for these reactions arise from recycling, or may be injected into the plasma as atom beams. In this paper I determine physical characteristics of a helium atom beam required for NPA and CXRS applications on JET, and what correspondence there is between these requirements and a standard JET PINI atom beam source. (Author).

28002 (JINR-E–15-92-315) **Novel approach to the determination of muon sticking to helium in the μCF reactions.** Fil'chenkov, V.V. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Nuclear Problems. 1992. [4p.] Order Number DE93630194. Source: OSTI; NTIS (US Sales Only); INIS.

Submitted to Muon Catalyzed Fusion.

In this paper it is shown that the measurements of the multiplicity of the μCF events in a definite time interval makes it possible to distinguish the fusion events interrupted because of the muon sticking to the helium nucleus from those events which are stopped due to the muon decay. 9 refs.; 1 fig.

28003 (JINR-R–15-92-312) **Time distribution of multicycle mu-catalyzed events.** Zinov, V.G. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Nuclear Problems. 1992. [4p.] (In Russian). Order Number DE93630195. Source: OSTI; NTIS (US Sales Only); INIS.

Submitted to Muon Catalyzed Fusion.

The paper draws attention to the fact that the time distribution of multicycle nuclear fusion events, initiated by an individual muon in

a mixture of hydrogen isotopes, essentially differs from the time distribution of the same events obtained after summation of the result over many muons. 1 ref.; 4 figs.

28004 (LA–12483-MS) **A PC-PCL-based control system for the high-voltage pulsed-power operation of the Intense Diagnostic Neutral Beam (IDNB) Experiment.** Gribble, R. Los Alamos National Lab., NM (United States). Jun 1993. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93014144. Source: OSTI; NTIS; INIS; GPO Dep.

A stand-alone, semiautomated control system for the high-voltage pulsed-power energy sources on the Intense Diagnostic Neutral Beam Experiment at Los Alamos National Laboratory using personal computer (PC) and programmable logic controller (PLC) technology has been developed and implemented. The control system, consisting of a PC with the graphic operator interface, the network connecting the PC to the PLC, the PLC, the PLC I/O modules, fiber-optic interfaces and software, is described.

28005 (LA-UR–93-1318) **Instability heating of the HDZP.** Lovberg, R.H. (California Univ., San Diego, La Jolla, CA (United States)); Riley, R.A.; Shlachter, J.S. Los Alamos National Lab., NM (United States). [1993]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9304126–5: 3. international conference on dense z-pinches, London (United Kingdom), 19-23 Apr 1993). Order Number DE93012641. Source: OSTI; NTIS; INIS; GPO Dep.

We present a model of dense Z-Pinch heating. For pinches of sufficiently small diameter and high current, direct ion heating by m=0 instabilities becomes the principal channel for power input. This process is particularly important in the present generation of dense micro-pinches (e.g., HDZP-II) where instability growth times are much smaller than current risetimes, and a typical pinch diameter is several orders smaller than that of the chamber. Under these conditions, m=0 formation is not disruptive: the large E_z field reconnects the instability cusps externally, after which the ingested magnetic flux decays into turbulent kinetic energy of the plasma. The continuous process is analogous to boiling of a heated fluid. A simple analysis shows that an equivalent resistance $R_t = \ell / 4\sqrt{N m_i (\mu_0/\pi)^{3/2}} I/r$ appears in the driving circuit, where I is the pinch current, N is the line density, ℓ is the pinch length, m_i is the ion mass, and r is the pinch radius. A corresponding heating term has been added to the ion energy equation in a 0-D, self-similar simulation, which had been written previously to estimate fusion yields and radial expansion of D_2 fiber pinches. The simulation results agree well with the experimental results from HDZP-II, where the assumption of only joule heating produced gross disagreement. Turbulent ion heating should be the dominant process in any simple pinch carrying meg-ampere current and having submillimeter radius.

28006 (LA-UR–93-1564) **The status of "Cold Fusion".** Storms, E. Los Alamos National Lab., NM (United States). [1993]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930804–1: 28. intersociety energy conversion engineering conference, Atlanta, GA (United States), 8-13 Aug 1993). Order Number DE93012731. Source: OSTI; NTIS; INIS; GPO Dep.

This report attempts to update the status of the phenomenon of cold fusion.

28007 (NIFS–194) **Eigenfunction for dissipative dynamics operator and attractor of dissipative structure.** Kondoh, Yoshiomi (Gunma Univ., Kiryu (Japan). Faculty of Technology). National Inst. for Fusion Science, Nagoya (Japan). Oct 1992. 14p. Order Number DE93508160. Source: OSTI; NTIS; INIS.

It is shown that the states with the minimum dissipation rate in general dissipative dynamics systems are expressed by the eigenfunctions for the dissipative dynamics operators. The eigenfunctions for the dissipative dynamics operators are shown to constitute the self-organized and self-similar decay phase as the attractor of the dissipative structure. (author).

28008 (NIFS–204) **Two-stream instability for a light ion beam-plasma system with external magnetic field.** Okada, T. (Tokyo Univ. of Agriculture and Technology, Koganei (Japan). Faculty of Technology); Tazawa, H. National Inst. for Fusion Science, Nagoya (Japan). Dec 1992. 14p. Order Number DE93508331. Source: OSTI; NTIS; INIS.

For inertial confinement fusion, a focused light ion beam (LIB) is required to propagate stably through a chamber to a target. We have pointed out that the applied external magnetic field is important for LIB propagation. To investigate the influence of the external magnetic field on the LIB propagation, we analysed the electrostatic dispersion relation of magnetized light ion beam-plasma system. The particle in-cell (PIC) simulation results are presented for a light ion beam-plasma system with external magnetic field. (author).

28009 (NIFS–206) **Tracking sharp interface of two fluids by the CIP (cubic-interpolated propagation) scheme.** Yabe, T. (Gunma Univ., Kiryu (Japan). Faculty of Technology); Xiao, F. National Inst. for Fusion Science, Nagoya (Japan). Jan 1993. 19p. Order Number DE93508322. Source: OSTI; NTIS; INIS.

A method to treat a sharp discontinuity by the density function is proposed. The surface of the density function is described by one grid throughout the calculation even when the surface is largely distorted. This description is made possible by the CIP method combined with variable transformation. This scheme is applied to the linear wave propagation in one- and two-dimensions. In the nonlinear case, the injection of heavier fluid into lighter fluid his calculated and the winding of mushroom structure is successfully treated by the density function. (author).

28010 (NIFS–207) **Simulation study of MHD dynamo: Convection in a rotating spherical shell.** Kageyama, A. (Hiroshima Univ. (Japan). Faculty of Science); Watanabe, K.; Sato, T. National Inst. for Fusion Science, Nagoya (Japan). Feb 1993. 46p. Order Number DE93508323. Source: OSTI; NTIS; INIS.

Numerical simulations on the thermal convection of a neutral fluid (without the magnetic field) in a rotating spherical shell have been carried out. The results indicate that if the rotation is sufficiently rapid, the fluid results in a strong differential rotation where an equatorial acceleration is remarkable. The formation dynamics of convection columns aligned to the rotation axis is studied extensively. A new model of generation mechanism of the differential rotation is then proposed which concludes that the fluid motion generates an equatorial acceleration by selectively exciting the cyclonic columns in the spherical shell. (author).

28011 (NIFS–208) **Plasma heating in toroidal systems.** Okamoto, Masao; Murakami, Sadayoshi. National Inst. for Fusion Science, Nagoya (Japan). Feb 1993. 17p. Order Number DE93508324. Source: OSTI; NTIS; INIS.

The purpose of this paper is to review the present status of plasma heating in toroidal systems (mainly tokamaks and helical systems) for astrophysical plasma scientists. The main method of plasma heating in toroidal systems or tori is to utilize fast ions (NBI heating and alpha heating). The maximum ion temperature of 38 keV has been achieved at the plasma center by neutral beam injections (NBIs) in the JT-60U tokamak. Ripple-trapped losses of fast ions produced by NBIs have been measured also in the JT-60U. The first tokamak discharges in deuterium-tritium fuelled mixtures have been carried out successfully in the JET tokamak. These experimental results are compared with the theoretical predictions based on the Coulomb collisions. Another powerful method is the ICRF heating (Ion Cyclotron Range of Frequency). However, this article will be focussed mainly on the NBI and alpha heatings. Related to plasma heating the current drive will be mentioned briefly placing an emphasis on the bootstrap current. (author).

28012 (NIFS–209) **Density dependence of line intensities and application to plasma diagnostics.** Masai, Kuniaki. National Inst. for Fusion Science, Nagoya (Japan). Feb 1993. 26p. Order Number DE93508325. Source: OSTI; NTIS; INIS.

Electron density dependence of spectral lines are discussed in view of application to density diagnostics of plasmas. The dependence arises from competitive level population processes, radiative and collisional transitions from the excited states. Results of the measurement on tokamak plasmas are presented to demonstrate the usefulness of line intensity ratios for density diagnostics. Also

general characteristics related to density dependence are discussed with atomic-number scaling for H-like and He-like systems to be helpful for application to higher density plasmas. (author).

28013 (NIFS–210) **R and D of transmission lines for ECH system.** Ohkubo, K.; Hosokawa, M.; Kubo, S.; Sato, M.; Takita, Y.; Kuroda, T. National Inst. for Fusion Science, Nagoya (Japan). Feb 1993. 21p. Order Number DE93508330. Source: OSTI; NTIS; INIS.

The performance of oversized transmission elements for millimeter waves is measured and compared with the calculation which is based on the superposition of plane wave (SPW) and on Fresnel approximation in the Huygens-Kirchhoff integral. Mode-conversion in the split waveguide is discussed from the viewpoint of on- and off-axes and 90-degrees elbow bend on phase correction is examined by using the SPW method. The design and experiment on the whispering gallery mode generator are described. A preliminary analysis of the rectangular waveguide with two corrugated plates and two plane walls is also carried out to obtain the Gaussian beam with a waist size of x-axis different from that of y-axis. (author).

28014 (NIFS–211) **Some features of particle orbit behavior in LHD configurations.** Shishkin, A.A.; Watanabe, K.Y.; Yamazaki, K.; Motojima, O.; Grekov, D.L.; Smirnova, M.S.; Zolotukhin, A.V. National Inst. for Fusion Science, Nagoya (Japan). Mar 1993. 50p. Order Number DE93508326. Source: OSTI; NTIS; INIS.

Localizations of helically trapped particle losses on the last closed magnetic surface in different LHD configurations are studied. The effects of electric field, finite β and bootstrap current are taken into account. It is shown that the angular location of the helically trapped particle losses may be controlled by the change of vertical field coil currents. (author).

28015 (NIFS–212) **Demonstration for novel self-organization theory by three-dimensional magnetohydrodynamic simulation.** Kondoh, Yoshiomi (Gunma Univ., Kiryu (Japan). Faculty of Technology); Hosaka, Yasuo; Liang, Jia-Ling. National Inst. for Fusion Science, Nagoya (Japan). Mar 1993. 21p. Order Number DE93508327. Source: OSTI; NTIS; INIS.

It is demonstrated by three-dimensional simulations for resistive magnetohydrodynamic (MHD) plasmas with both 'spatially nonuniform resistivity η' and 'uniformη' that the attractor of the dissipative structure in the resistive MHD plasmas is given by $\nabla \times (\eta j) = (\alpha/2)B$ which is derived from a novel self-organization theory based on the minimum dissipation rate profile. It is shown by the simulations that the attractor is reduced to $\nabla \times B = \lambda B$ in the special case with the 'uniformη' and no pressure gradient. (author).

28016 (NIFS–213) **Thermal and electric oscillation driven by orbit loss in helical systems.** Itoh, K.; Sanuki, H.; Itoh, S. National Inst. for Fusion Science, Nagoya (Japan). Mar 1993. 22p. Order Number DE93508328. Source: OSTI; NTIS; INIS.

Coupled oscillation of the radial electric field, the heating power and the plasma temperature in helical systems is analysed. This oscillation is caused by the influence of the radial electric field on the direct loss of injected fast ions. The damped oscillations of the radial electric field, temperature and fast-ion loss are predicted. Conditions for the mode and the dependence of the frequency are discussed. (author).

28017 (NIFS–214) **Effect of continuous eigenvalue spectrum on plasma transport in toroidal systems.** Yamagishi, Tomejiro (Fukui Inst. of Tech. (Japan)). National Inst. for Fusion Science, Nagoya (Japan). Mar 1993. 25p. Order Number DE93508329. Source: OSTI; NTIS; INIS.

The effect of the continuous eigenvalue of the Vlasov equation on the cross field ion thermal flux is investigated. The continuum contribution due to the toroidal drift resonance is found to play an important role in ion transport particularly near the edge, which may apply to the interpretation of the sharp increase of ion heat conductivity near the periphery observed in large tokamaks. (author).

28018 (NIFS-MEMO–7) **Chaotic phenomena in plasma, 2.** Kawai, Y. (ed.) (Kyushu Univ., Fukuoka (Japan)). National Inst. for Fusion Science, Nagoya (Japan). Nov 1992. 62p. (In Japanese). Order Number DE93508286. Source: OSTI; NTIS; INIS.

To review the present status of the research on plasma chaos, a working group was organized in 1990. The second meeting of the working group was held on December 1991 at National Institute for Fusion Science. This is the report of the second meeting, which contains both experimental and theoretical works. (author).

28019 (PPPL–2900) **Investigation of electrostatic waves in the ion cyclotron range of frequencies in L-4 and ACT-1.** Ono, Masayuki. Princeton Univ., NJ (United States). Plasma Physics Lab. May 1993. 46p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03073. Order Number DE93014592. Source: OSTI; NTIS; INIS; GPO Dep.

Electrostatic waves in the ion cyclotron range of frequencies (ICRF) were studied in the Princeton L-4 and ACT-1 devices for approximately ten years, from 1975 to 1985. The investigation began in the L-4 linear device, looking for the parametric excitation of electrostatic ion cyclotron waves in multi-ion-species plasmas. In addition, this investigation verified multi-ion-species effects on the electrostatic ion cyclotron wave dispersion religion including the ion-ion hybrid resonance. Finite-Larmor-radius modification of the wave dispersion relation was also observed, even for ion temperatures of $T_i \approx 1/40$ eV. Taking advantage of the relatively high field and long device length of L-4, the existence of the cold electrostatic ion cyclotron wave (CES ICW) was verified. With the arrival of the ACT-1 toroidal device, finite-Larmor-radius (FLR) waves were studied in a relatively collisionless warm-ion hydrogen plasma. Detailed investigations of ion Bernstein waves (IBW) included the verification of mode-transformation in their launching, their wave propagation characteristics, their absorption, and the resulting ion heating. This basic physics activity played a crucial role in developing a new reactor heating concept termed ion Bernstein wave heating. Experimental research in the lower hybrid frequency range confirmed the existence of FLR effects near the lower hybrid resonance, predicted by Stix in 1965. In a neon plasma with a carefully placed phased wave exciter, the neutralized ion Bernstein wave was observed for the first time. Using a fastwave ICRF antenna, two parasitic excitation processes for IBW – parametric instability and density-gradient-driven excitation – were also discovered. In the concluding section of this paper, a possible application of externally launched electrostatic waves is suggested for helium ash removal from fusion reactor plasmas.

28020 (PPPL–2905) **Experimental exploration of profile control in the Princeton Beta Experiment-Modified (PBX-M) tokamak.** Bernabei, S.; Bell, R.; Chance, M.; Chu, T.K.; Corneliussen, M.; Davis, W.; Gettelfinger, G.; Gibney, T.; Greenough, N.; Hatcher, R.; Hermann, H.; Ignat, D.; Jardin, S.; Kaita, R.; Kaye, S.; Kessel, C.; Kozub, T.; Hugel, H.; Lagin, L.; LeBlanc, B.; ManickaPrinceton Univ., NJ (United States). Plasma Physics Lab. May 1993. 34p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03073. Order Number DE93014818. Source: OSTI; NTIS; INIS; GPO Dep.

The experimental program of the Princeton Beta Experiment-Modified (PBX-M) Tokamak is directed towards tailoring plasma profiles to achieve greater stability and confinement and to gain access to the second stability region. Modification of the current density profile has been achieved with lower hybrid current drive (LHCD), leading to a regime free of global magnetohydrodynamic modes, while raising the value of q(O) above unity. The diffusion of the fast electrons produced by LHCD has been examined using two dimensional hard x-ray imaging. Ion Bernstein waves (IBW) have been used for ion heating: a preliminary analysis shows that ion heating was spatially localized and in agreement with theoretical calculations. Divertor biasing has modified the electric field inside the last closed surface, resulting in the formation of a transport barrier, which in turn has reduced the threshold power of Neutral Beam Injection (NBI) for H-mode transition by 25%.

28021 (PPPL–2906) **Numerical simulation of Bootstrap Current.** Wu, Yanlin; White, R.B. Princeton Univ., NJ (United States). Plasma Physics Lab. May 1993. 21p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03073. Order Number DE93014596. Source: OSTI; NTIS; INIS; GPO Dep.

The neoclassical theory of Bootstrap Current in toroidal systems is calculated in magnetic flux coordinates and confirmed by numerical simulation. The effects of magnetic ripple, loop voltage, and magnetic and electrostatic perturbations on bootstrap current for the

cases of zero and finite plasma pressure are studied. The numerical results are in reasonable agreement with analytical estimates.

28022 (PPPL–2907) **Theory of kinetic ballooning modes excited by energetic particles in tokamaks.** Tsai, Shih-Tung; Chen, Liu. Princeton Univ., NJ (United States). Plasma Physics Lab. May 1993. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03073. Order Number DE93014597. Source: OSTI; NTIS; INIS; GPO Dep.

We have analyzed theoretically the resonant excitations of kinetic ballooning modes (KBM) by the energetic ions/alpha particles in tokamaks. Our theory includes finite-size orbit effects of both circulating and trapped particles. With energetic-particle contributions suppressed in the singular inertial layer, an analytic.dispersion relation can then be derived via an asymptotic matching analysis. The dispersion relation, in particular, demonstrates the existence of two types of modes; that is, the magnetohydrodynamic (MHD) gap mode and the energetic-particle continuum mode. Specific expressions for real frequencies, growth rates and threshold conditions are also derived for a model slowing-down beam ion distribution function.

28023 (PPPL–2913) **Fast wave direct electron heating in TFTR.** Murakami, M.; Jaeger, E.F.; Rimini, F.G.; Rasmussen, D.A.; Stevens, J.E.; Wilson, J.R.; Batchelor, D.B.; Bell, M.; Budny, R.; Fredrickson, E.; Goldfinger, R.C.; Hammett, G.; Hoffman, D.J.; Hosea, J.C.; Janos, A.; Majeski, R.; Mansfield, D.; Phillips, C.K.;Princeton Univ., NJ (United States). Plasma Physics Lab. May 1993. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03073. (CONF-9304112–16: 10. topical conference on radio frequency power in plasmas, Boston, MA (United States), 1-3 Apr 1993). Order Number DE93014820. Source: OSTI; NTIS; INIS; GPO Dep.

Direct electron heating experiments were carried out in two regimes: B_T = 4.6 T with D^+ supershots; and B_T = 2.3 T with ^3He majority. The electron power deposition profiles measured with modulation of RF power are found to be strongly peaked in the core with the total volume-integrated power of up to 80% of the modulated power. The magnitude and profile shape agree well with those predicted by a full-wave code.

28024 (UCRL-CR–111879) **Long-pulse operation of a gyrotron with beam/rf separation.** Felch, K. (Varian Associates, Inc., Palo Alto, CA (US)); Chu, T.S.; Feinstein, J.; Huey, H.; Jory, H.; Neilson, J.; Schumacher, R. Lawrence Livermore National Lab., CA (United States); Varian Associates, Inc., Palo Alto, CA (United States). Sep 1992. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93015007. Source: OSTI; NTIS; INIS; GPO Dep.

Varian is carrying out the development of high-power, cw gyrotrons at frequencies ranging from 85–140 GHz. An experimental tube employing a $TE_{22.2.1}$-mode cavity and utilizing an output coupling concept where the collection of the spent electron beam is separated from the outgoing microwave power, has been designed and constructed. In initial tests on the tube, output powers of 450–500 kW have been obtained for pulse durations out to 2.5 seconds, in the desired $TE_{22.2.1}$ mode at a frequency of 110 GHz. Electron cyclotron resonance heating (ECRH) requirements for planned magnetic fusion experiments such as the International Thermonuclear Experimental Reactor (ITER) will require millimeter-wave sources capable of output powers of at least 1 MW cw at frequencies in the range, 100–200 GHz. Initial megawatt-level development work at Varian resulted in a gyrotron design that was tested to output powers of 1 MW for short pulses (~1 ms) and 400 kW for 0.5-s pulses at a frequency of 140 GHz. Output powers up to 1 MW have been achieved for short pulses (1 ms). Future tests on this and subsequent experimental tubes will be aimed at achieving 1 MW power levels under long-pulse and ultimately, cw conditions.

28025 (UCRL-JC–110953) **Kinetic simulations of ultra-intense laser plasma interactions.** Kruer, W.L.; Wilks, S.C. Lawrence Livermore National Lab., CA (United States). Jun 1992. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9206359–1: International conference on plasma physics (ICPP) - joint conference of the 9. Kiev international conference on plasma theory and the 9. international congress on waves and stabilities in plasma (ICWI, Innsbruck (Austria), 29 Jun - 3 jul Order Number DE93014419. Source: OSTI; NTIS; GPO Dep.

Kinetic simulations are used to investigate the interaction of an ultra-intense, small spot-size laser beam with a preformed plasma. the beam is sufficiently intense to drive the electrons relativistically and to impart a pressure in excess of hundreds of Mbars to the plasma. Key features of the interaction include generation of electrons and inward-directed ions with energies in the Mev range and strong hole boring which enhances the absorption. The simulations also show self-generated magnetic fields of order 10^8 Gauss, a Rayleigh-Taylor like instability of the light-plasma interface, as well as self-focusing of the laser beam and strong Raman backscatter.

28026 (UCRL-JC–111405) **Magnetic fusion computing: A personal retrospective view.** Killeen, J. (Lawrence Livermore National Lab., CA (United States)). Lawrence Livermore National Lab., CA (United States). Aug 1992. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-920813–3: Joint Varenna-Lausanne international workshop on theory of fusion plasmas, Varenna (Italy), 24-28 Aug 1992). Order Number DE93014147. Source: OSTI; NTIS; GPO Dep.

The association of computing with magnetic fusion research has a history of more than 30 years. Then, as now, the mathematical complexity of describing plasma phenomena has made the computer an indispensable tool in extending the theory. Our first area of application addressed fluid MHD models to represent ideal and resistive plasmas as well as equilibria. A second equally important area of research was in the solution of kinetic plasma models. Both Vlasov and Fokker-Planck models have been solved in the codes we developed, the latter allowing us to make realistic estimates of the transport of heat and particles in reacting fusion plasmas. The critical importance of computing to plasma physics research led us to the development of the dedicated computing facilities at NERSC (National Energy Research Supercomputer Center, Livermore). Aspects of these theoretical and institutional developments will be presented in a historical retrospective view.

28027 (UCRL-JC–111546) **Parametric instabilities in large nonuniform laser plasmas.** Baldis, H.A. (Lawrence Livermore National Lab., CA (United States)); Montgomery, D.S.; Moody, J.D.; Estabrook, K.G.; Berger, R.L.; Kruer, W.L.; Labaune, C.; Batha, S.H. Lawrence Livermore National Lab., CA (United States). Sep 1992. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-920610–16: ICPP 92: International conference on plasma physics, Innsbruck (Austria), 29 Jun - 3 jul 1992). Order Number DE93013184. Source: OSTI; NTIS; GPO Dep.

The study of parametric instabilities in laser plasmas is of vital importance for inertial confinement fusion (ICF). The long scale-length plasma encountered in the corona of an ICF target provides ideal conditions for the growth of instabilities such as stimulated Brillouin scattering (SBS), stimulated Raman scattering (SRS), and filamentation. These instabilities can have detrimental effects in ICF and their characterization and understanding is of importance. Scattering instabilities are driven through a feedback loop by which the beating between the electromagnetic EM fields of the laser and the scattered light matches the frequency of a local longitudinal mode of the plasma. Any process which interferes with the coherence of this mechanism can substantially alter the behavior of the instability. Of particular interest is the study of laser beam smoothing techniques on parametric instabilities. These techniques are used to improve irradiation uniformity which can suppress hydrodynamic instabilities. Laser beam smoothing techniques have the potential to control the scattering level from parametric instabilities since they provide not only a smoother laser intensity distribution, but also reduced coherence. Beam smoothing techniques that affect the growth of parametric instabilities include spatial smoothing and temporal smoothing by laser bandwidth. Spatial smoothing modifies the phase fronts and temporal distribution of intensities in the focal volume. The transverse intensity spectrum is shifted towards higher spatial wavenumber and can significantly limit the growth of filamentation. Temporal smoothing reduces the coherence time and consequently limits the growth time. Laser

bandwidth is required for most smoothing techniques, and can have an independent effect on the instabilities as well.

28028 (UCRL-JC–112154) **Charged-particle evaluation methodology at LLNL.** Resler, D.A.; White, R.M. Lawrence Livermore National Lab., CA (United States). Oct 1992. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-921046–18: Symposium on nuclear data evaluation methodology, Upton, NY (United States), 12-16 Oct 1992). Order Number DE93013429. Source: OSTI; NTIS; GPO Dep.

We recently completed charged-particle evaluations for reactions of hydrogen and helium important to fusion applications. In this paper we emphasize the methods developed which are unique to the evaluation of low-energy charged-particle data. In addition, we discuss general methods we developed to eliminate some of the tedious aspects of data evaluation such as the extraction of numerical values from graphs when tabulated experimental data are unavailable. We also discuss software tools developed for visualization of experimental data and to construct curves using a computer mouse or a variety of least-squares techniques ranging from simple polynomial and cubic-spline fits to R-matrix analyses.

28029 (UCRL-JC–112302) **Implicit multi-fluid simulation of interpenetrating plasmas.** Rambo, P.W.; Denavit, J. Lawrence Livermore National Lab., CA (United States). 3 Nov 1992. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9211128–8: 1992 nuclear explosives code developers conference, Sunnyvale, CA (United States), 2-6 Nov 1992). Order Number DE93013351. Source: OSTI; NTIS; INIS; GPO Dep.

A one dimensional simulation code for interpenetrating multicomponent plasmas is presented. Separate fluid equations for multiple species and the Poisson equation for the electric field are solved implicitly to allow stable accurate solutions over a wide range of the time scale parameters $\omega_p\Delta t$ and $\nu_c\Delta t$ (ω^p is the plasma frequency, ν_c a typical collision frequency and Δt the time step). In regions where $\omega_p\Delta t<<1$ and $\nu_c\Delta t<<1$, electron dynamics and space-charge effects are resolved, while in regions where $\omega_p\Delta t >>1$ and/or $\nu_c\Delta t>>1$, the ambipolar and/or diffusion models are recovered. In regions of low collisionality, particles may be created and deleted which are followed using particle and cell techniques combined with scatter and drag due to collisions with the fluids. Applications of this code to interpenetrating laser generated plasmas are presented.

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Refer also to citation(s) 25703, 26579, 26580, 26581, 26582, 26583, 26673, 26824, 26935, 26953, 27939, 27940, 27957, 27962, 27967, 27984

28030 (BNL–48642) **Nuclear fusion of protons with ions of boron.** Ruggiero, A.G. Brookhaven National Lab., Upton, NY (United States). [1993]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-9305136–1: International symposium on heavy ion fusion, Frascati (Italy), 25-28 May 1993). Order Number DE93015399. Source: OSTI; NTIS; INIS; GPO Dep.

This paper describes a method of extracting energy from the fusion events occurring between the collision of a beam of protons with a beam of ions of Boron 11. The two beams are circulating in separated and intersecting storage rings where they collide head-on in a common long-straight section. Requirements on the beam parameters in the collider are presented. Limitations due to space-charge forces are discussed; it is found necessary to provide beam-charge neutralization with electrons. The paper discusses also the effects of Coulomb scattering between particles of the same beam and in the opposing beams. Methods are proposed for the controlling of the electromagnetic interaction.

28031 (CEA-CONF–11304) **Experimental validation of Pd-Ag diffuser modeling.** Chabot, J.; Sannier, J. CEA Centre d'Etudes de Fontenay-aux-Roses, 92 (France). Service de la Corrosion, d'Electrochimie et Chimie des Fluides. 1992. [5p.] (CONF-920930–: 17. symposium on fusion technology, Rome (Italy), 14-18 Sep 1992). Order Number DE93632041. Source: OSTI; NTIS (US Sales Only); INIS.

In a nuclear fusion reactor the exhaust gas emanating from the plasma has to be reprocessed in order to separate hydrogen isotopes from impurities before recycling the DT mixture into the machine and releasing the gaseous wastes into the atmosphere. A favoured technique for the removing of the free deuterium and tritium is diffusion through Pd-alloy membranes. This process is well known but existing permeators are not really well adapted to NET operating conditions. In particular, the membrane geometry and the permeator configuration which can strongly affect permeator performances have to be optimized by considering NET specific requirements. Tubular finger Pd-Ag membranes of 1.35 to 5 mm diameter, 190 to 690 mm length and 0.1 mm thickness, have been tested comparatively in PALLAS II loop in order to determine their efficiency to hydrogen permeation as a function of length, diameter and cell annular space. Experiments were carried out at 300 deg C using a H_2-He gaseous mixture containing 5 vol% He under a pressure of 1.1 bar. For each membrane, the permeated hydrogen flow rate and the hydrogen concentration in the bleed were determined as a function of the bleed flow rate. Results illustrate the large dependence of performances to diameter and length whereas the influence of the annular space cell diameter appears to be small. However, for diameters $\geq$ 2.5 mm, the efficiency becomes diameter independent. Two membranes of 2.5 and 5 mm diameter and 690 mm long have been demonstrated as the more effective.

28032 (CONF-921103–13-App.C) **Burn control by refueling: Appendix C.** Hui, W.; Miley, G.H. Illinois Univ., Urbana, IL (United States). [1992]. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-90ER54092. From Meeting of the Division of Plasma Physics of the American Physical Society; Seattle, WA (United States); 16-20 Nov 1992. Order Number DE93013489. Source: OSTI; NTIS; INIS; GPO Dep.

This report construct the simplest model for describing the control of plasma burn with refueling.

28033 (CONF-9304112–13) **Folded waveguide designs for tokamaks.** Hoffman, D.J. (Oak Ridge National Lab., TN (United States)); Bigelow, T.S.; Fogelman, C.H.; Yugo, J.J.; Caughman, J.B.O.; Gardner, W.L.; Carter, M.D.; Probert, P.H.; Barbato, E. Oak Ridge National Lab., TN (United States). [1993]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 10. topical conference on radio frequency power in plasmas; Boston, MA (United States); 1-3 Apr 1993. Order Number DE93013274. Source: OSTI; NTIS; INIS; GPO Dep.

The folded waveguide (FWG) has been tested to the megawatt level in RFTF and shows great promise for tokamak use. It has three primary advantages: low electric field (anywhere) per unit power coupled to the plasma, strong structural capabilities, and better spectral content than loops. A tokamak test is now needed. Potential candidates include C-Mod at 80 MHz and FTU at 433 MHz. The waveguide test on the first machine will be directed at conventional ion cyclotron heating, while the test on the latter will be directed at direct electron heating. In addition, a variation of the folded waveguide is proposed to be tested on Phaedrus-T. In this paper, we discuss the advantages of the waveguide, the design layout, some of the potential physics programs, and how these programs may have an impact on its potential use in ITER.

28034 (CONF-9304112–17) **A preliminary engineering assessment of the ITER CDA ECH launcher.** Bigelow, T.S. (Oak Ridge National Lab., TN (US)); Swain, D.W.; Sawan, M. Oak Ridge National Lab., TN (United States). [1993]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 10. topical conference on radio frequency power in plasmas; Boston, MA (United States); 1-3 Apr 1993. Order Number DE93015441. Source: OSTI; NTIS; INIS; GPO Dep.

A preliminary engineering study of the ITER electron cyclotron heating (ECH) launcher configuration proposed by the ITER Conceptual Design Activity (CDA) team has been performed to assess its survivability in the ITER nuclear environment. Potential problem areas are with the vacuum windows, the plasma-facing mirrors, and some of the other high-power waveguide components that are untested in a reactor environment. The study indicates that the

CDA design is quite robust, since the mirror power density is relatively low and the windows are well shielded. Although the CDA ECH system is unlikely to be built as proposed, most analysis techniques developed to study this system will apply to future ITER ECH system configurations. The vacuum window is likely to be the most difficult launcher component to develop. Design for a proposed resonant ring for high-power testing of windows using existing lower-power gyrotrons is presented.

28035 (DOE/ER-ITER–0004) **International Thermonuclear Experimental Reactor.** USDOE Office of Energy Research, Washington, DC (United States). [1993]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48 ;AC05-84OR21400 ;AC02-76CH03073. Order Number DE93014828. Source: OSTI; NTIS; INIS; GPO Dep.

This is a general overview pamphlet on the ITER tokamak.

28036 (DOE/FTR–93011400) **[Travel to France to the IAEA technical committee meeting on atomic and molecular data for fusion reactor technology]: Foreign trip report, October 9–18, 1992.** Wilson, K.L. Sandia National Labs., Livermore, CA (United States). 1992. 33p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DR00789. Order Number DE93011400. Source: OSTI; NTIS (US Sales Only); GPO Dep.

K. L. Wilson participated in the IAEA Technical Committee Meeting on Atomic and Molecular Data for Fusion Reactor Technology held in Cadarache, France on October 12–16, 1992. In this meeting he gave two invited talks and served as a co-chair of the Plasma-Surface Interaction Data Working Group. Following the meeting, he participated in the International Fusion Research Council (IFRC) subcommittee on Atomic and Plasma-Material Interaction Data for fusion meeting held on October 16–17, 1992, at Cadarache.

28037 (DOE/FTR–93014983) **Travel to England to conduct an informal meeting of designated director and deputy directors for ITER: Foreign trip report, February 16, 1992–February 20, 1992.** Parker, R. Massachusetts Inst. of Tech., Cambridge, MA (United States). 16 Apr 1992. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-91ER54110. Order Number DE93014983. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report discusses planning schedules; design and development; senior positions; and start-up for the ITER tokamak.

28038 (ENEA-RT-INN–92-37) **Materials for structural and functional components in fission and fusion nuclear power reactors.** Casadio, S. ENEA, Casaccia (Italy). Area Energia e Innovazione. Dec 1992. 30p. (RT/INN–92-37). Order Number DE93799227. Source: OSTI; NTIS (US Sales Only); INIS.

In this work, a fast 'dolly shot' is reported about the criteria by which some materials have been candidated to be used for structural components and for nuclear-physico-chemical functions for fission and fusion power reactors. For the latter (which do not yet exist), new materials have to be developed for withstanding the very hard envisaged environmental operating conditions.

28039 (ENEA-RTI-PCM-IFEC–92-06) **Diffusion bonding as joining technique for fusion reactor components.** Ceccotti, G.C.; Magnoli, L. ENEA, Saluggia (Italy). Area Nucleare. Nov 1992. 11p. (CONF-920930–17: 17. symposium on fusion technology, Rome (Italy), 14-18 Sep 1992). Order Number DE93799234. Source: OSTI; NTIS (US Sales Only); INIS.

The development of joining techniques for fusion reactor divertors has been undertaken at ENEA (Italian Agency for Energy, New Technologies and the Environment) IFEC Saluggia. Joints were made by the diffusion bonding technique between graphite composite material with DS copper and with molybdenum TZM alloy, respectively. The inter-layers, when necessary, were obtained by metallization with an electronic gun. The same technique is employed in joining Be/SS, DS copper/Be, TZM/Be and graphite/Be for the first wall or plasma facing components of fusion reactors. In this case, a suitable inter-layer material can avoid the problems occuring with the more traditional brazing processes.

28040 (ENEA-RT-NUCL–91-06) **Elastic-plastic bucking analysis of TJ-II heliac device vacuum vessel.** Pizzuto, A.; Riccardi, B. ENEA, Frascati (Italy). Dipt. Fusione. Mar 1991. 8p. (CONF-910817–34: 11. international conference on structural mechanics in reactor technology (SMIRT-11), Tokyo (Japan), 18-23 Aug 1991; RT/NUCL–91-06). Order Number DE93799307. Source: OSTI; NTIS (US Sales Only); INIS.

The TJ II heliac device is a stellarator proposed for construction in Madrid by the Spanish Euratom-Ciemat Association. It is a medium sized heliac axis stellarator with four periods, a major radius of 1.5 m, a toroidal magnetic field up to 1 T, and a duty cycle up to 1s every five minutes. The parameters of the TJ II machine are reported in this paper. A very wide range of magnetic configurations with high rotational transform (0.9 to 2.5), low shear (1% to 10%), deep magnetic well (0 to 6%) and an average plasma radius between 0.1 and 0.2 m will be produced. The Vacuum Vessel (VV) is an independent component fixed on the machine supports. It is designed to follow the shape of the plasma, which consists of a helical column turned four times around a radius of 1.5 m. The VV is composed of 32 sectors and 32 rings (10 mm thick) in AISI 304 LN stainless steel to assure very low magnetic permeability values (less than 1.01). In order to place the central conductor coils as close as possible to the plasma, keeping them out-side the VV, a concave helical surface, or groove (6 mm thick) was provided. The VV is of modular construction and composed of eight octants and eight key rings to be assembled on site by means of bolts and then welded to ensure vacuum tightness. Each octant consists of four sectors and three rings: flanges at the ends allow the connections.

28041 (ENEA-RT-NUCL–91-08, pp. 10-14) **Properties of ablation cloud surrounding solid hydrogen pellets injected in tokamaks.** McNeill, D.H. ENEA, Frascati (Italy). Apr 1991. (CONF-910711–Exc.: 20. international conference on phenomena in ionized gases, Barga (Italy), 8-12 Jul 1991; RT/NUCL–91-08). In *Contributions to 20th international conference on phenomena in ionized gases.* 19p. Order Number DE93799235. Source: OSTI; NTIS (US Sales Only); INIS.

The injection of solid hydrogen pellets has been widely used for fuelling large fusion experiments. A variety of models have been developed for the ablation of pellets as they enter a hot plasma. Spectroscopic measurements have recently been made of the parameters of the luminous region surrounding pellets injected into tokamaks. These measurements have yielded electron densities n_e=1:3x10^{17} cm^{-3} and temperatures T_e=1.5:2 eV in the brightest region. This paper describes the results of some local thermodynamic equilibrium (LTE) model calculations based on the measured electron density and temperature that yield parameters such as the pressure, degree of ionization and dissociation of hydrogen, the density of the excited and ground states of hydrogen, and the intensities of continuum emission and three-body recombination in the luminous zone. These results can be used in estimating the rate of expansion of the ablation cloud and in analyzing the power balance of the ablation region. These problems are of general interest as an example of plasma-surface interactions in the extreme environment to which a pellet is subjected as well as, from the standpoint of understanding the physics of pellet fuelling.

28042 (ENEA-RT-NUCL–91-19) **Contributions to international conference of implications of new ICRP recommendations on radiation protection practice and interventions.** ENEA, Frascati (Italy). Dipt. Fusione. Oct 1991. 22p. (CONF-911105–Exc.: Symposium on implications of the new ICRP recommendations on radiological protection practices, Salamanca (Spain), 26-29 Nov 1991; RT/NUCL–91-19). Order Number DE93799291. Source: OSTI; NTIS (US Sales Only); INIS.

From the Contributions to the 'International Conference on Implications of the New ICRP Recommendations on Radiation Protection Practice and Interventions', separate abstracts were prepared for 2 papers which dealt with radiation protection for the Frascati neutron generator and for the NET (Next European Torus) and ITER (International Thermonuclear Experimental Reactor) experimental fusion reactor facilities. The papers examined planned radiation protection measures for these facilities in light of the occupational exposure safety provisions contained in the new ICRP (International Commission on Radiation Protection) recommendations.

28043 (ENEA-RT-NUCL–91-19, pp. 5-11) **Occupational radiation dose assessment process at research thermonuclear fusion plant.** Ciattaglia, S.; Lucci, F.; Sandri, S.; Cambi, G.; Cavallone, G. ENEA, Frascati (Italy). Oct 1991. (CONF-911105–Exc.: Symposium on implications of the new ICRP recommendations on radiological protection practices, Salamanca (Spain), 26-29 Nov 1991; RT/NUCL–91-19). In *Contributions to international conference of implications of new ICRP reccomandations on radiation protection practice and interventions.* 22p. Order Number DE93799291. Source: OSTI; NTIS (US Sales Only); INIS.

This paper presents the criteria adopted in order to evaluate the Occupational Radiation Exposure (ORE) during normal operation at a research thermonuclear fusion plants, like the Next European Torus (NET) or the International Tokamak Experimental Reactor (ITER), now in the design phase. The evaluation is part of the safety analysis process that has the purpose of permitting the optimization of protection, according to the basic recommendations of the ICRP. Direct irradiation, component and air activation and intake situations, as well as, number of workers, number of events and exposure time are considered. Accidental conditions and equipment failures are not considered unless they are due to events with high probability of occurrence so that such events might be expected during the life of the plant. Systems and components, whose location in the plant can affect radiological protection during maintenance and/or surveillance, are identified.

28044 (ENEA-RT-NUCL–91-22) **Development of beryllium bonds for plasma-facing components.** Franconi, E.; Ceccotti, G.C.; Magnoli, L. ENEA, Frascati (Italy). Dipt. Fusione; ENEA, Saluggia (Italy). Centro Ricerche Energia - Area Energia e Innovazione. Oct 1991. 16p. (CONF-911111–42: 5. international conference on fusion reactor materials (ICFRM-5), Clearwater, FL (United States), 17-22 Nov 1991; RT/NUCL–91-22). Order Number DE93799308. Source: OSTI; NTIS (US Sales Only); INIS.

The use of graphite as a plasma facing surface is limited due to strong erosion produced by a combination of physical and chemical sputtering, self-sputtering and radiation enhanced sublimation. The most promising alternative material appears to be beryllium which offers a number of potential advantages over graphite: oxygen impurities abatement, reduced tritium retention and reduced sputtering erosion. The greatest advantage seems to be the rapid and economical repair of the surfaces by means of spray deposition. However, a number of questions remain to be answered concerning the use of beryllium in high power tokamaks. Foremost amongst these are melting of the facing during disruptions, controversial data on self-sputtering yields, neutron irradiation effects, high operational thermal stresses and potential safety problems. This paper focuses on the techniques used to bond beryllium to structural and heat sink materials, and the characterization of the bonding material obtained. In tests of Be bonding to stainless steel and copper by the use of brazing alloys, best results were obtained with a silver-copper eutectic alloy. It was noted that the high temperature capability of the materials prepared by this method is limited by the performance of the brazing alloys at the operating temperature. To avoid this problem, a joining process known as solid state reaction bonding is being developed.

28045 (ENEA-RT-NUCL–92-02) **Membrane separation technologies: Their application to fusion reactors fuel cycle.** Violante, V.; Basile, A.; Drioli, E. ENEA, Frascati (Italy). Dipt. Fusione; Calabria Univ., Arcavacata di Rende (Italy). Dec 1992. 18p. (RT/NUCL–92-02). Order Number DE93799304. Source: OSTI; NTIS (US Sales Only); INIS.

The future fusion reactor fuel is a mixture of deuterium and tritium. The deuterium is available by means of traditional separation technology. The tritium, on the contrary, must be produced by means of a nuclear reaction between neutrons and lithium atoms within the reactor breeder which could be a lithiated ceramic material or a liquid metal containing lithium. The tritium produced in the breeder needs a proper extraction process to reach the required purity level. A conceptual modified version of the tritium recovery plant for a solid ceramic breeder, working with two membrane reaction/separation units, is studied in this work. The first membrane unit considered is a catalytic ceramic membrane reactor to remove, via oxidation, the hydrogen isotopes from the purge gas (He); the second is a Pd/Ag membrane permeator to separate the hydrogen isotopes from the watershift reactor gaseous products. The modelling and the mass balances were obtained on the basis of literature data.

28046 (ENEA-RT-NUCL–92-12) **Contributions to 10th international conference on plasma surface interactions.** ENEA, Frascati (Italy). Dipt. Fusione. May 1992. 42p. (CONF-920311–Exc.: 10. international conference on plasma-surface interactions in controlled fusion devices, Monterey, CA (United States), 30 Mar - 3 apr 1992; RT/NUCL–92-12). Order Number DE93799249. Source: OSTI; NTIS (US Sales Only); INIS.

From the Contributions to the 10th International Conference on Plasma Surface Interactions (Monterey, 30 March - 3 April, 1992), separate abstracts were prepared for 3 papers. The topics were: film deposition on metallic surfaces at liquid nitrogen temperature in view of the conditioning of the FT vacuum chamber; impurity screening in high-density limiter tokamaks; and the optimization of the Frascati Tokamak Upgrade limiter shape.

28047 (ENEA-RT-NUCL–92-12, pp. 5-15) **Film deposition on metallic surfaces at liquid nitrogen temperature in view of conditioning of FTU vacuum chamber.** Apicella, M.L.; Neri, A.; Verdini, L. ENEA, Frascati (Italy). May 1992. (CONF-920311–Exc.: 10. international conference on plasma-surface interactions in controlled fusion devices, Monterey, CA (United States), 30 Mar - 3 apr 1992; RT/NUCL–92-12). In *Contributions to 10th international conference on plasma surface interactions.* 42p. Order Number DE93799249. Source: OSTI; NTIS (US Sales Only); INIS.

The properties of carbon films on metallic surfaces at 77 degrees K, which is approximately the FTU (Frascati Tokamak Upgrade) wall temperature,were studied for the first time. Very good results, up to a maximum film thickness of 3 microns, were obtained. Evidence of blistering on the sample surface appeared only when the current density, during carbonization, exceeded considerably the value of 15 micro A/square centimeters.

28048 (ENEA-RT-NUCL–92-12, pp. 31-42) **Optimization of FTU toroidal limiter shape.** Ciotti, M.; Ferro, C.; Maddaluno, G. ENEA, Frascati (Italy). May 1992. (CONF-920311–Exc.: 10. international conference on plasma-surface interactions in controlled fusion devices, Monterey, CA (United States), 30 Mar - 3 apr 1992; RT/NUCL–92-12). In *Contributions to 10th international conference on plasma surface interactions.* 42p. Order Number DE93799249. Source: OSTI; NTIS (US Sales Only); INIS.

The FTU machine is now operating with an Inconel/stainless steel poloidal limiter. The necessity to withstand the large heat flux in the radio-frequency heating operational phase and to minimize plasma edge asymmetries has induced the feasibility of a toroidal limiter to be assessed. To take into account heat loads due to inevitable misalignements in the radial positioning of the limiter sectors, a 3-D analysis of the problem was carried out. Within this analysis, the shadowing between adjacent sectors was found to be the most critical factor because of the shortness of the energy decay length. In spite of the 3-D optimization of the limiter surface, peak heat load strongly increased with the safety factor at the edge and reaches up to a factor of four with respect to the average heat load.

28049 (ENEA-RT-NUCL–92-14, pp. 13-16) **Energy confinement of FTU ohmic plasma.** Alladio, F.; Berton, F.; Bracco, G.; Buratti, P.; Tudisco, O.; Bruschi, A.; De Luca, F.; Jacchia, A.; Mantica, P. ENEA, Frascati (Italy); Milan Univ. (Italy). Dipt. di Fisica. May 1992. (CONF-920610–Exc.: ICPP 92: International conference on plasma physics, Innsbruck (Austria), 29 Jun - 3 jul 1992; RT/NUCL–92-14). In *Contributions to 1992 international conference on plasma physics.* 40p. Order Number DE93799278. Source: OSTI; NTIS (US Sales Only); INIS.

The FTU (Frascati Tokamak Upgrade) has been operating in a wide range of plasma parameters. Typical performed plasma discharges are at: line averaged density = $2*10^{19}$:$1.5*10^{20}$ per cubic meter; magnetic field = 6 T; plasma current = 0.35:0.75 MA hydrogen and deuterium. The FTU plasma energy content is evaluated by making use of kinetic and magnetic measurements. Plasma geometry is obtained as the reconstruction of the plasma equilibrium

from magnetic diagnostics data. The electron temperature is measured by ECE analysis and the line averaged density profile is reconstructed with the use of equilibrium geometry and data from a 5 point DCN interferometer. Diamagnetic energy and equilibrium beta are also available. Effective ion charge is measured by an array of bremsstrahlung radiation detectors. Passive NPA provides information on the peak ion temperature whose profile is computed by solving the ion energy balance equation. A data base containing the confinement results for 500 plasma pulses has been prepared, and the most stationary conditions for each discharge have been chosen. The most striking feature of FTU plasma is the variety of line average density profiles, divided into flat and peaked profiles. This paper briefly comments on the most significant FTU results relative to confinement, heat pulse propagation and peaked density profiles.

28050 (ENEA-RT-NUCL–92-14, pp. 37-40) **Alfa-particle behaviour outside the last closed magnetic surface in divertor stellarators.** Alladio, F.; Batistoni, P.; Mancuso, A. ENEA, Frascati (Italy). May 1992. (CONF-920610–Exc.: ICPP 92: International conference on plasma physics, Innsbruck (Austria), 29 Jun - 3 jul 1992). In *Contributions to 1992 international conference on plasma physics.* 40p. Order Number DE93799278. Source: OSTI; NTIS (US Sales Only); INIS.

Usually, stellarators are characterized by high aspect ratios (A>10), however, the exploration of more compact aspect ratios is interesting due to the reduced winding size and the higher use of the magnetic field volume. However, the combination of toroidal effects with the helical ripples of the magnetic field raises concern about alpha particles confinement necessary for steady ignition. Recently, investigations have been made on the amount and the spatial distribution of direct collisionless losses of alpha particles in stellarators with varying aspect ratios. The studied configurations have been idealized stellarators with 1=2 poloidal winding number and with helicoidal surface currents distributed on circular tori, flowing with constant pitch in toroidal coordinates (that means a higher pitch in the outside and a lower pitch in the inside of the torus). Th e choice of this winding law has turned out to be a rewarding one since it has allowed a fully analytical treatment of the 3-D vacuum field and has permitted an easy access to low aspect ratios. The parameters of one of the most interesting configurations so far considered are: R*/a*=2.15 as the aspect ratio of the surface current distribution, A=4.35 as the plasma aspect ratio, M=9 as the toroidal winding number, t axis = 0.108 and t edge = 1.15, as the values of the rotational transform at the axis and at the edge respectively. The toroidal field has the usual ideal form, B_0R_0-R. All the configurations are characterized by very low ergodicity of the vacuum field, strong shear at the edge, and pronounced separatrix features.

28051 (ETDE-IT–93-186) **Behavior of SiC/Al coatings under high-dose irradiation with deuterium and helium ions.** Rubel, M.; Franconi, E.; Almqvist, N.; Emmoth, B.; Brossa, F. ENEA, Frascati (Italy). 1993. 20p. Order Number DE93799273. Source: OSTI; NTIS (US Sales Only); INIS.

Aluminium-silicon carbide coatings obtained by vacuum plasma spraying co-deposition are considered as a new class of plasma-facing materials (PFMs) for fusion devices. The technical requirements for PFMs are stringent since they have to withstand severe operation conditions, including bombardment by high fluxes of particles escaping the plasma. A number of Al/SiC coatings (containing 20 or 50% SiC) deposited on copper, stainless steel, or graphite substrates were irradiated under laboratory conditions with high doses of deuterium or helium ions. The surface properties of the materials were characterized before and after irradiation using several analytical techniques (RBS, NRA, SIMS, AES, EDS, microscopic methods, and laser profilometry). Exposures to low-energy deuterium ions or deuterium plasma resulted in the implantation of 7 - $9x10^{16}$ D cm^{-2} in the near-surface layer. The initial steps of blister formation were also observed. Changes in the surface structure were noted following irradiation with $4He^+$ ions (1.5 - 2 MeV). Damage in the surface layer of the materials was dependent on the ion flux.

28052 (EUR-CEA-FC–1481) **Computation of simulation of defects in carbon-metal composite soldering joints and comparison with experimental results by infra red imaging.** Lipa, M.; Deschamps, P.; Dufayet, A.; Chappuis, P.; Schlosser, J. Association Euratom-CEA, Centre d'Etudes de Cadarache, 13 - Saint-Paul-lez-Durance (France). Dept. de Recherches sur la Fusion Controlee. Feb 1993. [116p.] (In French). Source: OSTI; NTIS (US Sales Only); INIS.

Soldering defects of some components of TORE SUPRA are simulated by calculation and results are compared to nondestructive testing by infrared thermography of heated components. They are heated by two methods (1) By sending cold or hot water front in the cooling structure and simultaneous measurement of temperature evolution of tile surface versus time and (2) By deposition of a thermal flux on tiles with an electron gun and measurement of the surface temperature of the tile in steady state when heat is evacuated by the cooling water circuit. 42 figs.

28053 (GA-A–21281) **Results from the DIII-D advanced divertor program.** Schaffer, M.J. (General Atomics, San Diego, CA (United States)); Brooks, N.H.; Evans, T.E.; Groebner, R.J.; Hinton, F.L.; Hollerbach, M.A.; Hyatt, A.W.; Jackson, G.L.; Leonard, A.W.; Lippmann, S.I.; Mahdavi, M.A.; Osborne, T.H.; Petrie, T.W.; Sevier, D.L.;General Atomics, San Diego, CA (United States). Apr 1993. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-89ER51114 ;W-7405-ENG-48 ;AC05-84OR21400 ;FG03-89ER51121 ;AC04-76DP00789 ;AC03-89ER53277. (CONF-9305210–1: 9. International Atomic Energy Agency (IAEA) workshop on stellarators, Garching (Germany), 10-14 May 1993). Order Number DE93015472. Source: OSTI; NTIS; INIS; GPO Dep.

This paper presents a summary of some recent DIII-D boundary and divertor experiments. The single-null poloidally diverted plasmas were studied in the standard DIII-D open divertor configuration and in interaction with the toroidally symmetric divertor biasing electrode and exhaust pump. Results are reported for: scrape-off layer (SOL) density and its effect on impurity influx; SOL density and divertor bias; divertor pumping; divertor bias and exhaust gas collection; divertor bias and H-mode threshold.

28054 (GA-A–21311) **Variation of divertor plasma parameters with divertor depth for H-mode discharges in DIII-D.** Hill, D.N. (Lawrence Livermore National Lab., CA (United States)); Allen, S.L.; Jong, R.A.; Lasnier, C.; Porter, G.D.; Wood, R.; Petrie, T.W.; Brooks, N.H.; Evans, T.E.; Leonard, A.W.; Lippmann, S.I.; Mahdavi, M.A.; West, W.P.; Buchenauer, D.; Cuthbertson,General Atomics, San Diego, CA (United States). May 1993. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-89ER51114 ;W-7405-ENG-48 ;AC04-76DP00789 ;FG03-89ER51121. (CONF-930720–8: 20. European conference on controlled fusion and plasma physics, Lisbon (Portugal), 26-30 Jul 1993). Order Number DE93015475. Source: OSTI; NTIS; INIS; GPO Dep.

We report here the results of experiments aimed at quantifying the advantages of increasing the X-point to target-plate distance in a diverter tokamak operating with H-mode confinement. Larger distances should lower the peak electron temperature at the target plates, thereby reducing sputtering and lowering the impurity concentration in the care plasma. When gas puffing is used to reduce the diverter heat flux, extra field-line length may increase the volume available for radiation and increase gas isolation between the core and diverter regions.

28055 (LA-UR–93-2354) **A microsecond-pulsewidth, intense, light-ion beam accelerator.** Rej, D.J.; Bartsch, R.R.; Davis, H.A.; Greenly, J.B.; Waganaar, W.J. Los Alamos National Lab., NM (United States). [1993]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-930616–5: 9. IEEE pulsed power conference, Albuquerque, NM (United States), 21-23 Jun 1993). Order Number DE93016455. Source: OSTI; NTIS; INIS; GPO Dep.

A relatively long-pulsewidth (0.1-1 μs) intense ion beam accelerator has been built for materials processing applications. An applied-B_r, magnetically-insulated extraction ion diode with dielectric flashover ion source is installed directly onto the output of a 1.2-MV, 300-kJ Marx generator. Initial operation of the accelerator at 0.4 MV indicates satisfactory performance without the need for additional pulse-shaping.

28056 Apparatus for conversion of whispering-gallery modes into a free space Gaussian like beam. Stallard, B.W.; Makowski, M.A.; Byers, J.A. To Dept. of Energy. 1991. USA patent application 7-711,693. 28p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93015707. Source: OSTI; NTIS; INIS; GPO Dep.

An optical converter for efficient conversion of millimeter wavelength whispering-gallery gyrotron output into a linearly polarized, free-space Gaussian-like beam. The converter uses a mode-converting taper and three mirror optics. The first mirror has an azimuthal tilt to eliminate the k_ϕ component of the propagation vector of the gyrotron output beam. The second mirror has a twist reflector to linearly polarize the beam. The third mirror has a constant phase surface so the converter output is in phase.

28057 (PPPL-CFP–2819) **Power and particle control in the Tokamak Physics Experiment divertor.** Ulrickson, M.A. (Princeton Univ., NJ (United States)); Stotler, D.P.; Hill, D.N.; Rognlien, T.D.; Brooks, J.N.; Juliano, D.R.; Ruzic, D.N.; Werley, K.A. Princeton Univ., NJ (United States). [1993]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03073. (CONF-930720–4: 20. European conference on controlled fusion and plasma physics, Lisbon (Portugal), 26-30 Jul 1993). Order Number DE93014644. Source: OSTI; NTIS; INIS; GPO Dep.

The reference design for the Tokamak Physics Experiment (TPX) includes a double null divertor magnetic configuration. The main motivations for choosing the double null (DN) are the desire to operate with high triangularity (δ), DIII-D experimental results suggesting that high δ is favorable for advanced performance, theoretical indications that high δ is needed for access to the highest β regimes. The DN geometry also provides the flexibility to study the range of ℓ_i required for advanced tokamaks. TPX is being designed to have high plasma heating power (18–45 MW) and long pulse lengths (1000 s to steady state). The divertor configuration is capable of handling SN operation and a wide range of different plasma conditions (e.g., ℓ_i up to 1.6 and β_N up to 7). We will discuss the pumping speed required to maintain density control and the methods we have used to predict the particle throughput. Possibilities for improving divertor performance, such as a radiative divertor, are also discussed. The distance from the x-point to the divertor plate has been kept as long as practical (0.57 m in the poloidal plane and 16.3 m along a field line) in order to allow room for a radiative divertor.

28058 (PPPL-CFP–2821) **The mission and physics design of TPX.** Goldston, R.J. (Princeton Univ., NJ (United States). Plasma Physics Lab.); Jardin, S.; Kessel, C.; Liew, S.L.; Manickam, J.; Mikkelsen, D.; Pomphrey, N.; Reiersen, W.T.; Reiman, A.; Rewoldt, G.; Schmidt, J.A.; Sinnis, J.C.; Stotler, D.P.; Tang, W.; UlricksPrinceton Univ., NJ (United States). Plasma Physics Lab. [1993]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03073. (CONF-930720–3: 20. European conference on controlled fusion and plasma physics, Lisbon (Portugal), 26-30 Jul 1993). Order Number DE93014645. Source: OSTI; NTIS; INIS; GPO Dep.

The mission of the Tokamak Physics Experiment (TPX) is to develop the scientific basis for an economic, compact, and steady-state tokamak fusion reactor. This will require the development and demonstration of stable, steady-state tokamak operating regimes, with high β, high confinement, and high bootstrap fraction.

28059 (RTI-NUCL-FUS-BRA-ISP–90) **Reactivity and corrosion properties of metallic lithium candidate blanket breeder for fusion reactors.** Agostini, P.; Benamati, G. ENEA, Camugnano (Italy). Centro Ricerche Energia Brasimone - Area Nucleare. 1991. 44p. Order Number DE93799301. Source: OSTI; NTIS (US Sales Only); INIS.

This paper collects the most interesting data, from a technological point of view, relative to the reactivity of lithium and the behaviour of steels in presence of it. For this aim, extensive information is reported about the reactivity of lithium with different atmospheres. The influence of nitrogen content in lithium corrosion is pointed out.

28060 (SAND–93-1289C) **Physics of gas breakdown for ion beam transport in gas.** Olson, C.L. (Sandia National Labs., Albuquerque, NM (United States)); Poukey, J.W.; Hinshelwood, D.D.; Rose, D.V.; Hubbard, R.F.; Lampe, M.; Neri, J.M.; Ottinger, P.F.; Slinker, S.P.; Stephanakis, S.J.; Young, F.C.; Welch, D.R. Sandia National Labs., Albuquerque, NM (United States). [1993]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9305136–2: International symposium on heavy ion fusion, Frascati (Italy), 25-28 May 1993). Order Number DE93015646. Source: OSTI; NTIS; INIS; GPO Dep.

Detailed analysis, experiments, and computer simulations are producing a new understanding of gas breakdown during intense ion beam transport in neutral gas. Charge neutralization of beam micro clumps is shown to limit the net clump potentials to a non-zero value π_{min}, which can lead to divergence growth and axial energy spreading. At pressures $\gtrsim$ 1 Torr, plasma shielding should substantially reduce this effect Current neutralization has been studied in experiments on the GAMBLE II accelerator. The importance of fast electrons (knockons and runaways) has been established in IPROP simulations, which are in agreement with the experiments. For light ion fusion parameters with pressures $\gtrsim$ 1 Torr, very small net current fractions ($\ll$ 1%) appear feasible, permitting ballistic transport in gas. Self-pinched requires higher net current fractions ($\geq$ 2%) and preliminary IPROP code results indicate that this appears achievable for small-radius intense beams in lower pressure gases ($\gtrsim$Torr). Several self-pinched transport concepts look promising. The importance of these results for both light ion fusion and heavy ion fusion is discussed.

28061 (UCRL-ID–111954) **ITER-hard Toroidal Field coil structural analysis.** Wineman, S.J. Lawrence Livermore National Lab., CA (United States). 15 Oct 1992. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93014834. Source: OSTI; NTIS; INIS; GPO Dep.

The High Aspect Ratio Design (HARD) for the International Thermonuclear Experimental Reactor (ITER) has Toroidal Field (TF) coils that are farther out from the center of the Toroidal ring and more elongated than the previous design (CDA). These coils should see higher forces than in CDA and were designed accordingly. The objective of this work, conducted at LLNL and the MIT Plasma Fusion Center, was to determine whether stress levels in the ITER-HARD design are acceptable. A global finite element model, representing one of the coils, was modeled at MIT to obtain stresses and displacements both during operation of the TF coils alone, and during the End of Burn phase with TF and PF (Poloidal Field) coils operating. At LLNL, a detail model of the TF coil straight leg near the equator was used to obtain stresses and displacements during TF operation only. Further detailed analysis of the winding pack of this model was done to estimate stress concentrations in the conduit and insulation.

28062 (UCRL-ID–112569) **Method to prevent ejecta from damaging the Compact Torus Accelerator driver of an inertial fusion energy power plant.** Mattingly, S.E.K.; Moir, R.W. Lawrence Livermore National Lab., CA (United States). 16 Dec 1992. 23p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93013104. Source: OSTI; NTIS; INIS; GPO Dep.

Concern has been expressed about the conceptual design of fusion reactors using a Compact Torus Accelerator (CTA). A CTA accelerates a plasma torus toward a fusion target. When the torus nears the target, it is compressed and focused down to a small volume, creating a very high energy density and initiating a fusion micro explosion. The focusing cone is destroyed with each shot due to the stress from the passage of the torus as well as from the force of the explosion (1 800 MJ of yield, ~0.5 Ton TNT equivalent). The focusing cone could be made of solidified Li_2BeF_4; the same material used in liquid state to protect the reaction chamber from the micro explosion and to transport heat away to a power plant. The problem with this design is that when the focusing cone is shattered, the resulting small pieces of solid and liquid debris (ejecta) might be carded along by the expanding vapor of the explosion and might enter the CTA itself, causing damage and shortening the life of the CTA. The proposed solution for this possible problem is to bend the focusing cone so that the ejecta no

longer have a clear path to the CTA. Calculations show that the plasma torus may be sent through a radius of curvature of less than 0.5 m just after the focusing cone, without significantly disturbing the plasma.

28063 (UCRL-JC–108854) **The ETA-II linear induction accelerator and IMP wiggler: A high-average-power millimeter-wave free-electron-laser for plasma heating.** Allen, S.L.; Scharlemann, E.T. Lawrence Livermore National Lab., CA (United States). May 1992. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-930594–1: 9. international conference on high power particle beams, Washington, DC (United States), 25-29 May 1993). Order Number DE93013832. Source: OSTI; NTIS; INIS; GPO Dep.

We have constructed a 140-GHz free-electron laser to generate high-average-power microwaves for heating the MTX tokamak plasma. A 5.5-m steady-state wiggler (intense Microwave Prototype-IMP) has been installed at the end of the upgraded 60-cell ETA-II accelerator, and is configured as an FEL amplifier for the output of a 140-GHz long-pulse gyrotron. Improvements in the ETA-II accelerator include a multicable-feed power distribution network, better magnetic alignment using a stretched-wire alignment technique (SWAT). and a computerized tuning algorithm that directly minimizes the transverse sweep (corkscrew motion) of the electron beam. The upgrades were first tested on the 20-cell, 3-MeV front end of ETA-II and resulted in greatly improved energy flatness and reduced corkscrew motion. The upgrades were then incorporated into the full 60-cell configuration of ETA-II, along with modifications to allow operation in 50-pulse bursts at pulse repetition frequencies up to 5 kHz. The pulse power modifications were developed and tested on the High Average Power Test Stand (HAPTS), and have significantly reduced the voltage and timing jitter of the MAG 1D magnetic pulse compressors. The 2-3 kA. 6-7 MeV beam from ETA-II is transported to the IMP wiggler, which has been reconfigured as a laced wiggler, with both permanent magnets and electromagnets, for high magnetic field operation. Tapering of the wiggler magnetic field is completely computer controlled and can be optimized based on the output power. The microwaves from the FEL are transmitted to the MTX tokamak by a windowless quasi-optical microwave transmission system. Experiments at MTX are focused on studies of electron-cyclotron-resonance heating (ECRH) of the plasma. We summarize here the accelerator and pulse power modifications, and describe the status of ETA-II, IMP, and MTX operations.

28064 (UCRL-JC–110213) **Evolution of high-repetition-rate induction accelerators through advancements in switching.** Kirbie, H.C.; Caporaso, G.J.; Newton, M.A.; Yu, S.S. Lawrence Livermore National Lab., CA (United States). 20 Aug 1992. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9208109–88: 16. international LINAC conference, Ottawa (Canada), 23-28 Aug 1992). Order Number DE93012599. Source: OSTI; NTIS; GPO Dep.

Future applications of linear and recirculating induction accelerators include microwave sources for plasma heating and linear colliders, industrial manufacturing processes, and heavyion fusion. These applications require pulsed sources capable of sustained operation at high pulse-repetition rates. Powering these new accelerators places severe switching demands on the source that often can not be met with commercially-available technology. Consequently, several new accelerator switching schemes have been developed at Lawrence Livermore National Laboratory (LLNL). Our transition from spark-gap technology to magnetic switching has merged the formerly independent roles of source and cell into a single system and reshaped our design methods to emphasize high efficiency. Treatment of the accelerator as a system has also enabled us to optimize new accelerator designs based on cost considerations. Presently, we are developing a technology for driving a heavy-ion induction recirculator at pulse rates exceeding 100 kHz. In this case, the switching method is all solid state and the source and cell have evolved into a unified device.

28065 (UCRL-JC–111690) **Predicted performance of a dc beam driven FEM oscillator designed for fusion applications at 200-250 GHz.** Caplan, M. (Lawrence Livermore National Lab., CA (United States)); Best, R.W.B.; Verhoeven, A.G.A.; van der Wiel, M.J.; Urbanus, W.H.; Bratman, V.L.; Denisov, G.G. Lawrence Livermore National Lab., CA (United States). 21 Aug 1992. 22p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9208142–22: 14. international free electron laser conference, Kobe (Japan), 23-28 Aug 1992). Order Number DE93013414. Source: OSTI; NTIS; GPO Dep.

A Free Electron Laser using a DC beam with depressed collector is being developed at the FOM Institute (Netherlands) for plasma heating which will be capable of producing 1 MW CW output over an adjustable tuning range of 200-250 GHz. The basic design parameters for the electron beam, undulator and waveguide circuit are determined using a 3D non-wiggle averaged waveguide mode particle interaction code including AC space charge effects. Novel features of the design include using a step tapered two section wiggler to achieve both the high gain (10) and the required efficiency (~5%) as well as a rectangular corrugated HE_{11} waveguide circuit to handle the high average power requirements. Results are presented on FEM performance including dependence on beam emittance, percent feedback, and operating frequency.

28066 (UCRL-JC–112341) **Longitudinal beam dynamics for heavy ion fusion.** Callahan, D.A. (Lawrence Livermore National Lab., CA (United States)); Langdon, A.B.; Friedman, A.; Haber, I. Lawrence Livermore National Lab., CA (United States). 13 May 1993. 3p. Sponsored by USDOE, Washington, DC (United States); Department of Defense, Washington, DC (United States). DOE Contract W-7405-ENG-48 ;AI05-83ER40112 ;AI05-92ER54177. (CONF-930511–69: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93013850. Source: OSTI; NTIS; INIS; GPO Dep.

The longitudinal wall impedance instability is of great interest for a heavy ion fusion (HIF) driver because complete stabilization of this mode via momentum spread is impractical due to requirements of focusing the beam onto the inertial confinement fusion target. This instability is being studied with the WARPrz particle-in-cell code. The impedance of the induction linac modules is modeled as a wall impedance corresponding to a continuum of resistors and capacitors in parallel. We discuss simulations of the this instability, including reflections of perturbations off the beam end and the effects of finite temperature, and simulations of errors in intermittently-applied axial confining fields as a seed for this instability. We also present very long simulations in which we look for beam equilibria.

28067 (UCRL-JC–112361) **Impedance-power effects on plasma polymer surface finish using a helical resonator discharge.** Brusasco, R.; Ferguson, S.W.; Stever, R. Lawrence Livermore National Lab., CA (United States). 9 Dec 1992. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-930304–30: 205. American Chemical Society national meeting, Denver, CO (United States), 28 Mar - 2 apr 1993). Order Number DE93016454. Source: OSTI; NTIS; INIS; GPO Dep.

Plasma polymerized organic coatings are used in the fabrication of targets for experiments in the Inertial Confinement Fusion (ICF) program at Lawrence Livermore National Laboratory. The authors are performing experiments to understand the process conditions leading to the preparation of smooth (≈100Å) plasma polymer surfaces while maintaining the highest deposition rate possible. It had been reported by Howling et al., that the formation of particulate matter in the deposition of silicon by the plasma reaction of silane affected the plasma impedance. This suggested that experiments designed to examine the correlation of surface texture with plasma impedance would be of interest. Furthermore, it is possible that an impedance change may cause a change in the power coupling efficiency from the transmitter to the plasma. Preliminary work in the authors laboratory indicated that the reactor temperature influenced the surface texture. The focus of this paper is to carefully examine the effects of reactor temperature on the surface texture of the plasma polymer, ensuring constant reactor conditions especially with respect to rf power.

28068 (UCRL-JC–112378) **System modeling for the longitudinal beam dynamics control problem in heavy ion induction accelerators.** Payne, A.N. Lawrence Livermore National Lab., CA

(United States). 17 May 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-930511–213: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93016515. Source: OSTI; NTIS; INIS; GPO Dep.

We address the problem of developing system models that are suitable for studying the control of the longitudinal beam dynamics in induction accelerators for heavy ions. In particular, we present the preliminary results of our efforts to devise a general framework for building detailed, integrated models of accelerator systems consisting of pulsed power modular circuits, induction cells, beam dynamics, and control system elements. Such a framework will permit us to analyze and design the pulsed power modulators and the control systems required to effect precise control over the longitudinal beam dynamics.

28069 (UCRL-JC–113282) **Technology development for recirculating heavy-ion accelerators.** Newton, M.A.; Kirbie, H.C. Lawrence Livermore National Lab., CA (United States). 18 May 1993. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9305136–4: International symposium on heavy ion fusion, Frascati (Italy), 25-28 May 1993). Order Number DE93016545. Source: OSTI; NTIS; INIS; GPO Dep.

The "recirculator," a recirculating heavy-ion accelerator has been identified as a promising approach for an inertial fusion driver. System studies have been conducted to evaluate the recirculator on the basis of feasibility and cost. The recirculator has been shown to have significant cost advantages over other potential driver schemes, but some of the performance requirements exceed the capabilities of present technology. The system studies identified the high leverage areas where advances in technology will significantly impact the cost and performance of a recirculator. One of the high leverage areas is the modulator system which generates the acceleration potentials in the induction cells. The modulator system must be capable of generating the acceleration potentials at peak repetition rates in excess of 100 kHz with variable pulse widths. LLNL is developing a modulator technology capable of driving induction cells using the latest in solid state MOSFET technology. A small scale modulator has been built and tested to prove the concept and the next version is presently being designed. The objective is to demonstrate a modulator operating at 5 kV, 1 kA, with 0.2–1 μs pulse widths while driving an induction cell at >100 kHz within the next year. This paper describes the recirculator, the technology requirements necessary to implement it and the modulator system development that is being pursued to meet these requirements.

28070 (UCRL-JC–114505) **Three dimensional hydrodynamic calculations with adaptive mesh refinement of the evolution of Rayleigh Taylor and Richtmyer Meshkov instabilities in converging geometry: Multi-mode perturbations.** Klein, R.I. (Lawrence Livermore National Lab., CA (US)); Bell, J.; Pember, R.; Kelleher, T. Lawrence Livermore National Lab., CA (United States). Apr 1993. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9303126–4: 4. international workshop on the physics of compressible turbulent mixing, Cambridge (United Kingdom), 29 Mar - 1 apr 1993). Order Number DE93017155. Source: OSTI; NTIS; GPO Dep.

The authors present results for high resolution hydrodynamic calculations of the growth and development of instabilities in shock driven imploding spherical geometries in both 2D and 3D. They solve the Eulerian equations of hydrodynamics with a high order Godunov approach using local adaptive mesh refinement to study the temporal and spatial development of the turbulent mixing layer resulting from both Richtmyer Meshkov and Rayleigh Taylor instabilities. The use of a high resolution Eulerian discretization with adaptive mesh refinement permits them to study the detailed three-dimensional growth of multi-mode perturbations far into the non-linear regime for converging geometries. They discuss convergence properties of the simulations by calculating global properties of the flow. They discuss the time evolution of the turbulent mixing layer and compare its development to a simple theory for a turbulent mix model in spherical geometry based on Plesset's equation. Their 3D calculations show that the constant found in the planar incompressible experiments of Read and Young's may not be universal for converging compressible flow. They show the 3D time trace of transitional onset to a mixing state using the temporal evolution of volume rendered imaging. Their preliminary results suggest that the turbulent mixing layer loses memory of its initial perturbations for classical Richtmyer Meshkov and Rayleigh Taylor instabilities in spherically imploding shells. They discuss the time evolution of mixed volume fraction and the role of vorticity in converging 3D flows in enhancing the growth of a turbulent mixing layer.

99 GENERAL AND MISCELLANEOUS

28071 (DOE/ER/75636–1) **Exhibit-based energy teaching at the Exploratorium: Final report, September 1, 1991–August 31, 1992.** Exploratorium, San Francisco, CA (United States). 1992. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-91ER75636. Order Number DE93016288. Source: OSTI; NTIS; GPO Dep.

Exhibits were developed which explored transfer of energy (water pumping, photosynthesis). Publications were also developed on the first and second laws of thermodynamics, and on air pollution.

28072 (DOE/ER/75842–1) **[Workshop for coordinating South Carolina's pre-college systemic initiatives in science and mathematics].** South Carolina Univ., Columbia, SC (United States). [1992]. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-92ER75842. (CONF-9208223–Summ.: Mathematics and sciences education summit, Fripp Island, SC (United States), 28-30 Aug 1992). Order Number DE93012263. Source: OSTI; NTIS; GPO Dep.

On December 19, 1991, South Carolina's Governor, established the Governor's Mathematics and Sciences Advisory Board (MSAB) to articulate a vision and develop a statewide plan for improving science and mathematics education in South Carolina. The MSAB recognized that systemic change must occur if the achievement levels of students in South Carolina are to improve in a dramatic way. The MSAB holds two fundamental beliefs about systemic change: (1) All the elements of the science and mathematics education system must be working in harmony towards the same vision; and (2) Each element of the system must be held against high standards and progress must be assessed regularly against these standards.

28073 (DOE/RL/12523–1) **Math and Science School (MASS): A Department of Energy enhancement program to benefit students from Native American Tribes affected by the Hanford Reservation: Progress report.** Jaeger, M. Eastern Oregon State Coll., La Grande, OR (United States). 20 Mar 1993. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG06-92RL12523. Order Number DE93015061. Source: OSTI; NTIS; GPO Dep.

Math and Science School is a program designed to enrich and encourage elementary students and teachers of the Confederated Tribes of the Umatilla Indian Reservation in the areas of mathematics and science activities. By providing access to special hands-on workshop sessions held in the mobile science laboratory at the school sites during the school year for students and teachers and with a separate summer inservice program for students, elementary children and teachers are encouraged to explore the fascination of science and the utility of mathematics through use of integrated curricula. The Department of Energy grant underwrites the instructional costs of this system while the grantee provides the mobile laboratory and the majority of the materials.

9901 Management

Refer also to citation(s) 26154, 26238, 26314, 26327, 26407, 26436, 26833, 27255, 27256, 27264

28074 (DOE/AD–0046) **DOE real property: A yearly statistical handbook, Fiscal year 1992.** USDOE Office of the Associate Deputy Secretary for Field Management, Washington, DC (United States). 1992. 104p. Sponsored by USDOE, Washington, DC

(United States). Order Number DE93015997. Source: OSTI; NTIS; GPO Dep.

To assist in the tracking, reporting, and management of the real property, DOE has an automated inventory information system. This handbook was prepared as a resource for DOE officials and others who have a need to reference real property data as part of their day-to-day functions. It is intended as an internal working document, and the information therein is a compilation or analysis of data in the information system. It is divided into: land, buildings, and other structures and facilities.

28075 (DOE/ER/75730–1) **Evaluation and capacity building to improve precollege science and mathematics achievement in the US: 10 CFR, Part 605: Technical progress report, June–December 1992.** Network, Inc., Andover, MA (United States); National Center for Improving Science Education, Andover, MA (United States). [1992]. 277p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-92ER75730. Order Number DE93016309. Source: OSTI; NTIS; GPO Dep.

The National Center for Improving Science Education has undertaken activities to achieve evaluation goals for DOE's Precollege programs: develop means to determine program quality; develop means for determining the contribution of DOE precollege programs to both teacher enhancement and student achievement; provide evaluation designs and instruments and reports of program quality and impact; and strengthen both DOE's and the Labs' capacity to do both short- and long-term planning as well as deliver effective programs and evaluation. Appendices include evaluation/technical assistance report, profiling teacher research participation and teacher development programs, teacher surveys, impact assessment design, and teacher research participation programs anecdotes for 8 labs.

28076 (DOE/IG–0328) **Audit of Mound Plant's reduction in force.** USDOE Office of Inspector General, Oak Ridge, TN (United States). Eastern Regional Audit Office. 17 May 1993. 32p. Sponsored by USDOE, Washington, DC (United States). Source: OSTI (Free of Charge).

Report to The Secretary.

Objective of this audit was to determine whether the Mound Plant's Fiscal Year 1992 reduction in force (RIF) was effectively managed and implemented properly by DOE. DOE established policy to encourage contractors to reduce staffing by voluntary separations without unreasonable separation costs. EG&G Mound's FY 1992 RIF was accomplished by voluntary separations; however, its implementation unreasonably increased costs because DOE did not have adequate criteria or guidelines for evaluating contractors' RIF proposals, and because EG&G Mound furnished inaccurate cost data to DOE evaluators. The unreasonable costs amounted to at least $21 million. Recommendations are made that DOE develop and implement guidelines to impose limitations on voluntary separation allowances, early retirement incentive payments, and inclusion of crucial employee classifications in voluntary RIFs.

28077 (DOE/IG–0329) **Inspection of management of excess personal property at Rocky Flats.** USDOE Office of Inspector General, Washington, DC (United States). Office of Inspections. 17 May 1993. 34p. Sponsored by USDOE, Washington, DC (United States). Source: OSTI (Free of Charge).

Report to The Secretary.

Inspection revealed that immediate management attention is needed to properly control, store, and dispose of excess personal property at Rocky Flats. Current system of operation does not allow for efficient, timely, cost effective management; current storage and disposal practices are not consistent with contract requirements or DOE policies and procedures. Other deficiencies are pointed out. Results of inspection are divided into 4 sections: contract changeover issues, moratorium issues, additional excess property issues, and award fee observations. Recommendations are outlined.

28078 (DOE/PR–0048) **Department of Energy listing of awardee names active awards.** USDOE Office of Procurement, Assistance and Program Management, Washington, DC (United States). 6 Apr 1993. 519p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93016903. Source: OSTI; NTIS; GPO Dep.

This DOE procurement and assistance data system (PADS) for active awards, lists awardee name/division, bin, completion date, description of work, vendor ID, city, state, congressional district, contract value, obligations to data, and P/S.

28079 (EDF-DER-RA–1992-1) **D.E.R. 92 - Main facts.** Electricite de France (EDF), 92 - Clamart (France). 1992. [143p.] (In French). Order Number DE93631737. Source: OSTI; NTIS (US Sales Only); INIS.

This report presents the main facts of the studies carried out by the Direction des Etudes et Recherches (DER) of Electricite de France: new applications of electricity, classical and nuclear thermal power plants, electrical equipment, environment protection, network analysis, information and informatic equipment.

28080 (EGG-M–93143) **Creating a strategic plan for configuration management using computer aided software engineering (CASE) tools.** Smith, P.R.; Sarfaty, R. EG and G Idaho, Inc., Idaho Falls, ID (United States). [1993]. 26p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. (CONF-9304134–1: 1993 National Department of Energy (DOE)/contractors and facilities data acquisition and control user's group meeting, Livermore, CA (United States), 13-16 Apr 1993). Order Number DE93013663. Source: OSTI; NTIS; INIS; GPO Dep.

This paper provides guidance in the definition, documentation, measurement, enhancement of processes, and validation of a strategic plan for configuration management (CM). The approach and methodology used in establishing a strategic plan is the same for any enterprise, including the Department of Energy (DOE), commercial nuclear plants, the Department of Defense (DOD), or large industrial complexes. The principles and techniques presented are used world wide by some of the largest corporations. The authors used industry knowledge and the areas of their current employment to illustrate and provide examples. Developing a strategic configuration and information management plan for DOE Idaho Field Office (DOE-ID) facilities is discussed in this paper. A good knowledge of CM principles is the key to successful strategic planning. This paper will describe and define CM elements, and discuss how CM integrates the facility's physical configuration, design basis, and documentation. The strategic plan does not need the support of a computer aided software engineering (CASE) tool. However, the use of the CASE tool provides a methodology for consistency in approach, graphics, and database capability combined to form an encyclopedia and a method of presentation that is easily understood and aids the process of reengineering. CASE tools have much more capability than those stated above. Some examples are supporting a joint application development group (JAD) to prepare a software functional specification document and, if necessary, provide the capability to automatically generate software application code. This paper briefly discusses characteristics and capabilities of two CASE tools that use different methodologies to generate similar deliverables.

28081 (IC–93/88) **Situating the history of technology in a philosophical triptych: Contours for future research.** Raina, D. International Centre for Theoretical Physics, Trieste (Italy). May 1993. [28p.] Order Number DE93628573. Source: OSTI; NTIS (US Sales Only); INIS.

This is a review of recent developments in the field of the history of technology, infused as it is by the extension of the sociology of science to the sociology of technology. However, this review is directed at the rather ambitious task of outlining the methodological precepts for studying the advent of the discourse of modern and appropriate technologies in India. Hence it is a review that seeks to delineate an approach that would circumvent some of the traditional difficulties with the history of technology, that will be discussed ahead. (author). 23 refs.

28082 (INIS-GB–483) **Rutherford Appleton Laboratory.** Rutherford Appleton Lab., Chilton (United Kingdom). [1993]. [24p.] Order Number DE93631738. Source: OSTI; NTIS (US Sales Only); INIS.

Rutherford Appleton Laboratory (RAL), described in this document, supports a wide variety of projects. Each year more than 1000 scientists and engineers visit RAL to use its world-class laser and neutron-scattering facilities. RAL staff design and build instruments which circle the Earth in satellites, increasing our understanding of ozone depletion and global warming, of the life cycles of stars and galaxies and, indeed, of the origin of the Universe itself. They work with their academic colleagues at international laboratories such as European Organization for Nuclear Research (CERN), Geneva, where massive underground machines probe the microstructure of the atomic nucleus. Vastly complex calculations are carried out on the design of anti-cancer drugs, for example, using supercomputers at RAL. (author).

28083 (INIS-JP–013) **Technical publications by JAERI staff in 1992, vol. 26.** Japan Atomic Energy Research Inst., Tokyo (Japan). May 1993. 121p. Order Number DE93508345. Source: OSTI; NTIS; INIS.

This list contains 969 references published as technical reports by JAERI and selected from JAERI personnel's papers in journals and other publications in 1992. A bibliographic description for each entry consists of title, carrier language, author(s) and source. The references fall into three groups. While JAERI report and JAERI-M report groups are sorted by report number, Papers-in-Journals group is arranged by the first author. The indexes are both by personal author and corporate entry. (author) 969 refs.

28084 (RAL–92-050-V1) **ISIS annual report for the financial year 1 April 1991 to 31 March 1992. V. 1.** Wilson, C. Rutherford Appleton Lab., Chilton (United Kingdom). Jul 1992. [154p.] Order Number DE93631739. Source: OSTI; NTIS (US Sales Only); INIS.

Volume 1 of the 1992 Annual Report of ISIS, the neutron scattering facility based at the Rutherford Appleton Laboratory contains details of the work of the Facility over the past year. In addition to reports on the status of the accelerator and instruments, instrument developments, support facilities, publications etc, Volume 1 contains summaries of the science performed, often with reference to reports contained in the current volume. In addition, there are more extended articles highlighting a range of recently performed experiments. (author).

28085 (RAL–92-050-V2) **ISIS annual report for the financial year 1 April 1991 to 31 March 1992. V. 2.** Wilson, C. Rutherford Appleton Lab., Chilton (United Kingdom). Jul 1992. [394p.] Order Number DE93631740. Source: OSTI; NTIS (US Sales Only); INIS.

This, Volume 11 of the 1992 Annual Report of ISIS the neutron scattering facility at Rutherford Appleton Laboratory contains the Experimental Reports on those experiments carried out on ISIS in the year ending 31 March 1992. Included are Experimental Reports from work performed on 14 ISIS instruments (13 neutron and one muon beam), and the number and quality of these reports reflects very well upon the standard of experiments performed at the Facility. The continuing increase in productivity of ISIS, which has extended through the initial development stage of the source, demonstrates that much new science continues to be done at ISIS, and that with the development and provision of new instruments, the scientific output of the Facility will continue to show strong growth. These Experimental Reports are intended as interim summaries of the measurements made during an ISIS experiment and as such may not contain the final conclusions of the analysis. They do, however, give a general flavour of the range and type of science performed on each instrument. (author).

28086 (Riso-R–680(EN)) **Environmental Science and Technology Department annual report 1992.** Jensen, A.; Gissel Nielsen, G.; Gundersen, V.; Nielsen, O.J.; Oestergaard, H.; Aarkrog, A. (eds.). Risoe National Lab., Roskilde (Denmark). Mar 1993. [91p.] Order Number DE93631741. Source: OSTI; NTIS; INIS.

Through basic and strategic research, the Environmental Science and Technology Department aspires to develop new ideas for industrial and agricultural production thus exerting less stress and strain on the environment. The department endeavours to develop a competent scientific basis for future production technology and management methods in industrial and agricultural production. The research approach in the department in predominantly experimental. Selected department research activities during 1992 are introduced and reviewed in seven chapters: 1. Introduction. 2. The Atmospheric Environment. 3. Plant Genetics and Resistance Biology. 4. Plant Nutrition and Mineral Cycling. 5. Chemistry of the Geosphere. 6. Ecology and Mineral Cycling. 7. Other Activities. The department's contribution to national and international collaborative research programmes in presented in addition in formation about large research and development facilities used and management by the department. The department's educational and training activities are included in the annual report along with lists of publications, publications in press, lectures and poster presentations at international meetings. The names of the scientific and technological staff members, visiting scientists, Post. doctoral fellows, Ph.D. students and M.Sc. students are also listed. (au).

28087 (SAND–93-0480C) **Creating and maintaining a visionary quality program.** Shirley, K.W.; Spencer, A.C. Sandia National Labs., Albuquerque, NM (United States). [1993]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9309168–1: 2. international symposium on productive and quality improvement with a focus on government, Washington, DC (United States), 8-10 Sep 1993). Order Number DE93015122. Source: OSTI; NTIS; GPO Dep.

Developing a business plan that focuses on quality is not enough. Use quality principles to affect change and improve your organization's performance. Current management practices at Sandia National Laboratory are presented.

28088 (SR/H–524) **[Hanford] Service Department: Plant.** [Plant histories]. Hanford Engineer Works, Richland, WA (United States). [1946]. 174p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. Order Number DE93012364. Source: OSTI; NTIS (US Sales Only); GPO Dep.

As its name implies, the Service Department of TNX Operations at Hanford has been responsible for the several and diversified service-type functions common to plants operated by the du Pont Company. These normal duties include employment, industrial relations and training, selective service, safety and fire protection, laundry operation, and janitor services. At Hanford, this department also has operated the two Central Files (300 and 700 Areas), which has involved special classified document control. This document reviews Service Department (Plant) functions and organization from the early arrival of the Superintendent, in May 1943 to July 1, 1945.

28089 (SSI–92-11) **The history of radioactive wastes.** Persson, Lars. Swedish Radiation Protection Inst., Stockholm (Sweden). Jun 1992. [16p.] (In Swedish). Order Number DE93631742. Source: OSTI; NTIS; INIS.

The report gives a short history of the swedish views and politics concerning the management and disposal of radioactive wastes. A period of 40 years is reviewed.

28090 (SSI–92-14) **Research programs 1992/93 radiation protection.** Swedish Radiation Protection Inst., Stockholm (Sweden). Aug 1992. [23p.] (In Swedish). Order Number DE93631743. Source: OSTI; NTIS; INIS.

Radiation protection research programs are summarized. The main fields are: ionizing and non-ionizing radiation, radioactive wastes, radiation accidents, dosimetry, epidemiology, radiobiology and radioecology.

28091 (SSI–93-02) **Survey and evaluation of the external research and development programme 1977-1983 of the Swedish Radiation Protection Institute.** Persson, Lars. Swedish Radiation Protection Inst., Stockholm (Sweden). Jan 1993. [33p.] Order Number DE93631744. Source: OSTI; NTIS; INIS.

A review of the external research programme of SSI is undertaken. The main research programme is in this report divided into five subprogrammes according to the main programmes of the Institute. This report covers research projects reported 1977-1983. An evaluation of the impact of the R and D programme is included in the report. The external R and D research programme of SSI has had an important impact on the radiation protection work in

Sweden. The methods for evaluation of research programmes are also discussed in the report.

28092 (SSI–93-03) **The SSI reviews of the SKB research programs 1992.** Jensen, Mikael. Swedish Radiation Protection Inst., Stockholm (Sweden). Feb 1993. [29p.] (In Swedish). Order Number DE93631745. Source: OSTI; NTIS; INIS.

The Swedish Radiation Protection Institute (SSI) has scrutinized the research programs 1992 of the Swedish Nuclear Fuel and Waste Management Co (SKB). The judgement is that SKB has both the competence and resources to perform the presented research programs.

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Refer also to citation(s) 25524, 25560, 25573, 25589, 25590, 25632, 25698, 25702, 25711, 25728, 25732, 25742, 25746, 25749, 25759, 25832, 25849, 25850, 25871, 25892, 26030, 26091, 26117, 26124, 26152, 26156, 26157, 26160, 26221, 26223, 26232, 26239, 26259, 26260, 26261, 26273, 26330, 26339, 26360, 26361, 26367, 26368, 26369, 26370, 26371, 26381, 26386, 26388, 26392, 26393, 26398, 26510, 26521, 26529, 26555, 26685, 26708, 26723, 26766, 26890, 26899, 26900, 26901, 26906, 26908, 26909, 26913, 26914, 26918, 26930, 26931, 26937, 26940, 27002, 27003, 27019, 27054, 27076, 27102, 27110, 27151, 27206, 27207, 27231, 27232, 27239, 27240, 27244, 27268, 27269, 27280, 27294, 27295, 27320, 27326, 27327, 27344, 27353, 27374, 27376, 27380, 27387, 27392, 27402, 27435, 27450, 27456, 27526, 27529, 27530, 27609, 27626, 27634, 27638, 27655, 27669, 27674, 27724, 27729, 27810, 27827, 27850, 27865, 27866, 27869, 27871, 27872, 27876, 27877, 27878, 27879, 27971, 28070

28093 (ANL/MCS/CP–78726) **Simplification-driven automated partial evaluation.** Boyle, J.M. Argonne National Lab., IL (United States). Mathematics and Computer Science Div. 21 Nov 1992. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9306162–1: ACM SIGPLAN symposium on partial evaluation and semantics based program manipulation, Gothenburg (Sweden), 14-16 Jun 1993). Order Number DE93012890. Source: OSTI; NTIS; GPO Dep.

I describe an automated approach to partial evaluation based on simplification and implemented by program transformations. The approach emphasizes program algebra and relies on canonical forms and distributive laws to expose instances to which simplifications can be applied. I discuss some of the considerations that led to the design of this approach. This design discussion should be useful both in understanding the structure of the partial evaluation transformations, and as an example of how to approach the design of automated program transformations in general. This approach to partial evaluation has been applied to a number of practical examples of moderate complexity, including: the running example used in this paper, proving an identity for lists, and eliminating a virtual data structure from a specification of practical interest. The chief practical barrier to its wider application is the growth of the intermediate program text during partial evaluation. Despite this limitation, this approach has the virtues of being implemented, automated, and able to partially evaluate specifications containing implicit data, including some specifications of practical interest.

28094 (BNL–48968) **Randomized unannounced inspections at any time.** Lu, Ming-Shih. Brookhaven National Lab., Upton, NY (United States). [1993]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-930533–4: 15. annual symposium of the European Safeguards Research and Development Association: safeguards and nuclear materials management, Rome (Italy), 11-13 May 1993). Order Number DE93014285. Source: OSTI; NTIS; INIS; GPO Dep.

A general model of randomized inspections for unannounced inspections at any time is proposed. The model is designed to satisfy the existing IAEA inspection criteria including both timeliness and detection probability goals. In addition, the inspection effectiveness is enhanced significantly since inspections may commence at any time. Evaluation of the results of inspections implemented according to the model does not require changes in the concept of timeliness or the use of "average" detection time. Potential significant savings in inspection resources arising from the application of the model are estimated.

28095 (CIEMAT–708) **A communication network for LHC detector readout.** Romero, L. Centro de Investigaciones Energeticas, Medioambientales y Tecnologicas (CIEMAT), Madrid (Spain). 1993. 29p. Order Number DE93502573. Source: OSTI; NTIS.

This paper describe a network architecture for data taking in LHC environment. The network is composed of 64 rings of point to point links working at 100 Mbytes/s. The network connect the front end electronics, computer farms and two data switches. The efficiency of the system is discussed. Using extracted 1 kbyte events for the 2nd level trigger and whole 1 Mbyte events for the 3rd level trigger, then the system can sustain working rates of 2 x 10"5 and 2 x 10"3events/s going into the 2nd and 3rd level triggers. System resistance to errors is discussed. (Author)

28096 (CONF-910414–41) **Parallelization of a spherical S_N algorithm based on the spatial domain decomposition.** Haghighat, A. (Pennsylvania State Univ., University Park, PA (United States). Dept. of Nuclear Engineering); Azmy, Y.Y. Oak Ridge National Lab., TN (United States). [1991]. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From International topical meeting on advances in mathematics, computation and reactor physics; Pittsburgh, PA (United States); 28 Apr - 2 may 1991. Order Number DE93015816. Source: OSTI; NTIS; GPO Dep.

The SN method is an approximate approach used to solve the linear Boltzmann transport theory equation. This method requires a significant amount of memory and computational time which are limiting factors for its utility in real-life applications. In the past decade, the significant advancements in computer hardware design (vector and parallel processing) have provided the possibility of development of new parallel/vector software which can operate significantly faster than the older serial/scalar ones. In, recent years, several studies have been performed on the vector/parallel processing of the SN transport theory method. This paper primarily discusses a parallel algorithm for the S. method which is based on decomposition of the spatial domain. Wienke and coworkers have performed studies on the energy domain and have obtained significant speedups. Azmy considered angular parallelization of a one-group x-y nodal SN algorithm and recently Rhoades and Flanery performed angular parallelization for a x-y-z SN transport formulation. Haghighat and Mattis considered angular parallelization of a curvilinear SN algorithm. For parallelization based on the spatial domain decomposition only one study has been reported by Yavuz and Larsen who demonstrated the possibility of spatial decomposition for a slab geometry on a sedal machine. In the present work, we develop a spatial parallel formulation for spherical geometry and study its behavior under different physical conditions. Then, we describe our implementation of the algorithm on the Cornell National Supercomputer Facility IBM 3990/600J with six processors and measure speedups for different problem sizes.

28097 (CONF-9210270–, pp. 1-7) **A SISAL code for computing the fourier transform on S_N.** Novoa, J. (Univ. of Puerto Rico, Mayaguez (PR)); Sanmiguel, F.; Seguel, J. Lawrence Livermore National Lab., CA (United States). Dec 1992. Grant RII-8905080. From 2. sisal users' conference; San Diego, CA (United States); 4-5 Oct 1992. In *Proceedings of the second SISAL users' conference.* 273p. Order Number DE93008019. Source: OSTI; NTIS.

Non-abelian FFT's appear in connection with the statistical analysis of ranked data. Fast algorithms for computing non-abelian FFTs that are based upon a generalization of common FFT techniques have been proposed. However, the presence in non-abelian FFTs of group representations makes the coding of a non-abelian FFT much more complex, in particular, no parallel or vector implementations can be naturally derived by manipulating the non-abelian FFT mathematical formulas. In this paper, a SISAL code based on an almost direct translation of the mathematical expression of an FFT on the symmetric group S_N is presented. Especially useful features in SISAL in expressing the algorithm are ragged arrays and dynamic sized arrays.

28098 (CONF-9210270–, pp. 9-20) **Five ways to fill your knapsack.** Boehm, W.; Egan, G. Lawrence Livermore National Lab., CA (United States). Dec 1992. From 2. sisal users' conference; San Diego, CA (United States); 4-5 Oct 1992. In *Proceedings of the second SISAL users' conference.* 273p. Order Number DE93008019. Source: OSTI; NTIS.

We compare five solutions to the zero-one knapsack problem: Divide and Conquer, Depth First with Bound, Dynamic Programming, Memo Functions, and Branch and Bound. Our programs are written in Sisal and run on the CSIRAC II dataflow machine. Two of the algorithms, Memo Functions and Branch and Bound, benefit from non deterministic extensions of Sisal, put and get. We introduce these extensions and compare the performance of the five algorithms using knapsacks of 20 and 40 objects. We measure the performance of our programs in S_1: the number of instructions executed, S_∞: the critical path length, and $\pi = [S_1/S_\infty]$: the average parallelism. It turns out that the Branch and Bound algorithm performs best in terms of S_1, especially for the harder test cases.

28099 (CONF-9210270–, pp. 21-24) **Simulating material dislocation motion in SISAL.** Strailey, M.T. Jr.; Tibbits, P.; DeBoni, T. Lawrence Livermore National Lab., CA (United States). Dec 1992. From 2. sisal users' conference; San Diego, CA (United States); 4-5 Oct 1992. In *Proceedings of the second SISAL users' conference.* 273p. Order Number DE93008019. Source: OSTI; NTIS.

The goal of this project is to develop a computer model in Sisal to simulate the movement of dislocations in metal-class materials undergoing high temperature deformation. The project expands previous work in simulating the movement of dislocations. The new model will be able to handle more dislocations and eventually will model curved dislocation lines in three-dimensional space. It is hoped that this new model will be able to elucidate the mechanism by which Persistent Slip Bands (PSB's) form. The decision to implement the model in Sisal was influenced by the Sisal Scientific Computing Initiative's offer of free supercomputer time. The model tracks the motion of the dislocations by solving a system of coupled ordinary differential equations. The heart of our simulation then is the Runge-Kutta-Fehlberg integrator used to solve this system of equations. This process is expected to parallelize well because identical computations are used for each of the dislocations. With the integrator recently completed and only preliminary results available, the main focus of this paper will be on our experiences with using Sisal to implement a preliminary project, the simulation of dislocation pileup formation. This simulation will be used to verify our results against previous simulations and the analytical results.

28100 (CONF-9210270–, pp. 25-34) **Candis as an interface for SISAL.** Raymond, D.J. (Geophysical Research Center, Socorro, NM (US)). Lawrence Livermore National Lab., CA (United States). Dec 1992. Grant ATM-8914116. From 2. sisal users' conference; San Diego, CA (United States); 4-5 Oct 1992. In *Proceedings of the second SISAL users' conference.* 273p. Order Number DE93008019. Source: OSTI; NTIS.

Candis stands for "C language analysis and display", and is a system developed by the author for analyzing and displaying gridded numerical data. It has been in regular use at New Mexico Tech for a number of years, and is being used at a number of other institutions as well. The basic idea of Candis is to apply the UNIX filter paradigm to non-ASCII, gridded numerical data. In order to make this possible, a standardized, self-describing data format has been adopted. Details can be found in Raymond (1988). The advantage of this system is that complex applications can be constructed by piping together a number of standard Candis utilities. Its main applications have been the analysis and display of data from meteorological observation systems and the analysis of numerical model output. Both of these applications typically have data in the form of rectangular grids of varying dimensions. In this paper I describe an interface between Candis and SISAL (McGraw, et. al, 1985). For SISAL applications that produce gridded numerical data, this provides a simple way to take advantage of the strengths of both systems - computations are done using SISAL and the results are analyzed using Candis.

28101 (CONF-9210270–, pp. 35-43) **Parallelisation and performance of the Burg Algorithm on a shared memory multiprocessor.** Cricenti, A.L. (Swinburne Institute of Technology, Hawthorn (AU)); Egan, G.K. Lawrence Livermore National Lab., CA (United States). Dec 1992. From 2. sisal users' conference; San Diego, CA (United States); 4-5 Oct 1992. In *Proceedings of the second SISAL users' conference.* 273p. Order Number DE93008019. Source: OSTI; NTIS.

This paper describes the implementation of a signal processing algorithm, specifically the Burg Algorithm, using both a high level at parallel language SISAL and Encore Parallel FORTRAN. The Burg Algorithm is an estimation technique for fitting an autoregressive model to a time series data set. This algorithm contains a time shift/timer product operation which is used in a number of other important signal processing algorithms such as convolution. The paper describes the results obtained using both the high level parallel language SISAL and EPF, on both an ENCORE Multimax multiprocessor machine, and a single processor IBM RS6000/530 machine.

28102 (CONF-9210270–, pp. 45-57) **Use of genetic algorithms in SISAL to solve the file design problem.** Cedeno, W. (Lawrence Livermore National Lab., CA (US)). Lawrence Livermore National Lab., CA (United States). Dec 1992. DOE Contract W-7405-ENG-48. From 2. sisal users' conference; San Diego, CA (United States); 4-5 Oct 1992. In *Proceedings of the second SISAL users' conference.* 273p. Order Number DE93008019. Source: OSTI; NTIS.

The File Design Problem is a N-P-complete problem normally encountered in the design of databases. The goal is to find an assignment of database records to files that minimizes the average number of files examined over all single attribute queries. This paper describes a solution to the File Design Problem using Genetic Algorithms written in SISAL. Using the portability and architecture independence inherent in SISAL a Genetic Algorithm model is defined that provides increased performance without the sacrifice of convergence. A heuristic based mating operator essential to the solution to the problem is described. Selection and replacement operators useful for multimodal function optimization are used to search for multiple solutions. Results with various test cases are shown. Performance of the algorithm is shown for different platforms.

28103 (CONF-9210270–, pp. 59-65) **Implementing FFT's in SISAL.** Bollman, D. (Univ. of Puerto Rico, Mayaguez (PR)); Sanmiguel, F.; Seguel, J. Lawrence Livermore National Lab., CA (United States). Dec 1992. Grant RII-8905080. From 2. sisal users' conference; San Diego, CA (United States); 4-5 Oct 1992. In *Proceedings of the second SISAL users' conference.* 273p. Order Number DE93008019. Source: OSTI; NTIS.

Tensor notation is a powerful tool for improvising fast Fourier transform (FFT) algorithms in a functional language. In this work we apply this idea to the development of FFT's in the functional language Sisal. As an example, we develop a high performance Sisal implementation of a variant of Pease's FFT on a Cray Y-MP. Although the utility of tensor notation for FFT algorithms has long been recognized, it has been only recently that this notation has gained wide spread acceptance by FFT practitioners. Tensor notation aids not only in algorithm expression and comprehension, but also in algorithm development and is an ideal tool for developing parallel-vector algorithms for functional programs. In this work we describe work in progress that exploits this idea to develop a family of high performance FFT's in the functional language Sisal. As an example, we present a high performance Sisal implementation of a variant of the radix 4 Pease algorithm. In this section, we establish definitions and notation. In Section 2, we review a well-known family of FFT's that are variants of the original Cooley-Tukey algorithm and discuss their implementations in Sisal. In Sections 3 and 4 we compare Sisal implementations of variants of the radix 4 Korn-Lambiote and Pease algorithms. The Pease variant outperforms Korn-Lambiote as well as Cann's implementation of Stockham's algorithm.

28104 (CONF-9210270–, pp. 67-82) **Programming and evaluating the performance of signal processing applications in the SISAL programming environment.** Yoon, Daekyun (Univ. of Southern California, Los Angeles (US)); Gaudiot, J.L. Lawrence Livermore National Lab., CA (United States). Dec 1992. Grant CCR-9013965. From 2. sisal users' conference; San Diego, CA

(United States); 4-5 Oct 1992. In *Proceedings of the second SISAL users' conference.* 273p. Order Number DE93008019. Source: OSTI; NTIS.

This paper presents a signal processing application and its implementation in the SISAL programming environment. It shows that a signal processing application can be effectively coded in SISAL and can be analyzed to investigate the feasibility of its parallel implementation using the SISAL tools. We also present the implementation of Fast Fourier Transform (FFT) which is a kernel of many signal processing applications on the Sequent Symmetry systems. It is shown that exploiting function call parallelism can be more effective than the parallel loop slicing for some applications.

28105 (CONF-9210270–, pp. 83-92) **SISAL and Von Neumann-based languages: Translation and intercommunication.** Yoshikawa, C. (Univ. of Cincinnati, OH (US)); Ghia, U.; Osswald, G.A. Lawrence Livermore National Lab., CA (United States). Dec 1992. From 2. sisal users' conference; San Diego, CA (United States); 4-5 Oct 1992. In *Proceedings of the second SISAL users' conference.* 273p. Order Number DE93008019. Source: OSTI; NTIS.

SISAL is a functional programming language useful for creating programs that can be easily exploited for parallelism, run on a wide range of platforms (Cray, Iris, IBM RS/6000, etc.), and run at serial speeds competitive with FORTRAN. In order to take advantage of SISAL's speed and parallelism, however, it is necessary to extensively rewrite existing FORTRAN code or create new code m SISAL. Translating from a language such as FORTRAN to SISAL is not particularly easy, since SISAL's data is comprised of semantically immutable values. Therefore, it was decided to test the performance of a combination of a FORTRAN driver and a SISAL subroutine. Consequently, extensive rewriting of the original FORTRAN code is not necessary and the program performance can be expected to increase due to SISAL's decided advantages. Since documentation of a FORTRAN/SISAL interface is not widespread and the corresponding performance is not well understood, what data should be examined to evaluate the resulting performance is itself an area of investigation. However, the experience and information acquired concerning the functional and Von Neumann language interface should prove to be didactic, at worst. The present paper attempts to identify the approach needed to translate code and create the interface, while detailing the communication between a FORTRAN driver and a SISAL subroutine. Also, the performance gain or loss will be reviewed.

28106 (CONF-9210270–, pp. 93-109) **An IF2 code-generator for ADAM architecture.** Mitrovic, S. (Institut fuer Technische Informatik und Kommunikationsnetze, Zuerich (CH)). Lawrence Livermore National Lab., CA (United States). Dec 1992. Grant 2.309-0.86. From 2. sisal users' conference; San Diego, CA (United States); 4-5 Oct 1992. In *Proceedings of the second SISAL users' conference.* 273p. Order Number DE93008019. Source: OSTI; NTIS.

Project ADAM is based on research work in the area of parallel computers. ADAM architecture can be described as von Neumann/dataflow hybrid or coarse-grain dataflow architecture. The project encompasses development and analysis of a novel parallel architecture and corresponding tools. A register-level simulator allows quick changes of design parameters and a detailed monitoring of machine behavior. Programmability of architecture can be proved only by running existing programs written in high-level languages. Therefore, research results are obtained with an architecture simulator and code-generators for high-level languages. The detailed simulator called Metamachine was implemented and a processing element was realized in hardware. Software environments, new languages for parallel processors and a code-generator for applicative language Sisal have been programmed by members of ADAM project. The project involved seven people over a period of five years. The research work resulted in various software tools and a number of experiments that verified the performance and illuminated the problems of ADAM architecture. This paper presents one part of ADAM project. It describes the code-generator that uses IF2 intermediate form to generate assembler code for Metamachine. IF2 is generated by optimizing SISAL compiler system (OSC) [FeoCannOldeh9O]. The author assumes that the reader has a knowledge of Sisal and its syntax [McGrSkedz85]. IF1 [SkedzGlau84] and IF2 [WelSkeYaRan86] graphs are hierarchic acyclic dataflow graphs that are stored in text files.

28107 (CONF-9210270–, pp. 111-137) **Program partitioning for NUMA multiprocessor computer systems.** Wolski, R. (Lawrence Livermore National Lab., CA (US)); Feo, J. Lawrence Livermore National Lab., CA (United States). Dec 1992. DOE Contract W-7405-ENG-48. From 2. sisal users' conference; San Diego, CA (United States); 4-5 Oct 1992. In *Proceedings of the second SISAL users' conference.* 273p. Order Number DE93008019. Source: OSTI; NTIS.

An important part of parallel programming is program partitioning and scheduling. Partitioning is the separation of program operations into sequential tasks, and scheduling is the assignment of tasks to the processors of a computer system. To be effective, automatic methods require an accurate representation of the model of computation and the target architecture. Current partitioning methods assume the macro-dataflow model of computation and the homogeneous/two-level architectural model. The former is typically represented as a directed, acyclic graph of computation nodes and communication edges. The edges map directly to communication channels, but not read/write memories. Consequently, current methods optimize assuming the presence of communication channels, and not the complex memory systems of NUMA architectures-they fail to optimize for a critical component of these architectures. In this paper, we extend the conventional graph representation of the macro-dataflow model to enable mapping heuristics to work with a NUMA architectural model. We describe two such heuristics. Simulated execution times of programs show that our model and heuristics generate higher quality program mappings than current methods.

28108 (CONF-9210270–, pp. 139-159) **Mapping functional parallelism on distributed memory machines.** Pande, S.S. (North Carolina State Univ., Raleigh (US)); Agrawal, D.P.; Mauney, J. Lawrence Livermore National Lab., CA (United States). Dec 1992. Grant DDAL03-91-G-0031. From 2. sisal users' conference; San Diego, CA (United States); 4-5 Oct 1992. In *Proceedings of the second SISAL users' conference.* 273p. Order Number DE93008019. Source: OSTI; NTIS.

In order to effectively use the power of newer massively parallel multicomputers, exploitation of functional parallelism in a program with automatic data and code distribution, is a necessity. Functional paradigm offers a relative ease of generating an intermediate form that abstracts the DAG parallelism in the program, in an interprocedural framework. Using the Sisal intermediate form IF-2, a new task-based methodology has been outlined to effectively map functional parallelism on distributed memory multicomputers. A new compile time method that investigates the trade-off between the schedule length and the number of required processors, partitions the IF-2. The partition is appropriately scaled at run time to match the available processors, to avoid recompilation. The run time system is designed around an arbitrator processor and several worker processors. The arbitrator processor manages the control thread of the Sisal program and is also responsible for the housekeeping jobs like task assignment to the workers and ownership resolution of the task variables. Each of the workers await tasks to be assigned by the arbitrator and use the ownership information maintained at the arbitrator to obtain the live definition of a variable. Many implementation issues related to supporting call by value and virtual address mechanism are addressed. Benchmark results are presented to demonstrate the viability of the approach.

28109 (CONF-9210270–, pp. 161-173) **Implicit array copying: Prevention is better than cure.** Roe, P. (Univ. of Adelaide (SA)); Wendelborn, A. Lawrence Livermore National Lab., CA (United States). Dec 1992. From 2. sisal users' conference; San Diego, CA (United States); 4-5 Oct 1992. In *Proceedings of the second SISAL users' conference.* 273p. Order Number DE93008019. Source: OSTI; NTIS.

SISAL is a purely functional language which supports arrays. The difficulty with supporting purely functional arrays is that a prohibitive amount of copying can be necessary. SISAL uses a sophisticated compile-time analysis to alleviate some copying

associated with array operations. This compile-time analysis is discussed and some problems with it are exposed. The alternative to curing, copying, is to prevent it. To this end we propose a linear ADT, inspired by Wadler's monads work. Our linear ADT may be incorporated into Haskell and other functional languages. It allows efficient functional assignment on arrays. In addition it allows efficient divide and conquer style algorithms to be expressed using array partitioning and concentation. The latter is particularly useful for expressing parallel array algorithms.

28110 (CONF-9210270–, pp. 175-191) **Mathematical syntax for SISAL.** Arya, A.K.; Woods, D. Lawrence Livermore National Lab., CA (United States). Dec 1992. From 2. sisal users' conference; San Diego, CA (United States); 4-5 Oct 1992. In *Proceedings of the second SISAL users' conference.* 273p. Order Number DE93008019. Source: OSTI; NTIS.

This paper presents a mathematical syntax which can be generated from SISAL 2.0 and the tool to generate this mathematical form automatically. This tool is envisioned to be incorporated into a SISAL 2.0 translator. We contend that a mathematical syntax would be closer to a native language for computer users especially those well founded in mathematics. In addition, this mathematical form is suitable for overheads and textbook with the added benefit that the mathematical form is guaranteed to be syntatically correct. This will enhance the understandability presented programs. The example translations contained here are intended as a starting point for standardizing on mathematicalized SISAL and would be interested in others peoples ideas. There is no reason to prevent the extension of our approach to arbitrary functional languages.

28111 (CONF-9210270–, pp. 193-208) **An approach for optimizing recursive functions.** Fitzgerald, S.M. (Univ. of Massachusetts, Lowell (US)); Wilkens, L. Lawrence Livermore National Lab., CA (United States). Dec 1992. From 2. sisal users' conference; San Diego, CA (United States); 4-5 Oct 1992. In *Proceedings of the second SISAL users' conference.* 273p. Order Number DE93008019. Source: OSTI; NTIS.

Within the SISAL programming environment, existing optimization techniques do not address recursive functions. This limitation restricts the performance of many applications. One approach is to transform recursive solutions into their iterative counterparts, thus allowing existing techniques to optimize the resulting form. In this paper, we discuss the issues involved in converting a recursive function into an equivalent iterative form. An outline of an algorithm which performs a source-to-source transformation on tail recursive SISAL functions is presented. We then discuss the issues involved in generalizing this approach.

28112 (CONF-9210270–, pp. 209-222) **Implementing arrays in SISAL 2.0.** Oldehoeft, R.R. Lawrence Livermore National Lab., CA (United States). Dec 1992. From 2. sisal users' conference; San Diego, CA (United States); 4-5 Oct 1992. In *Proceedings of the second SISAL users' conference.* 273p. Order Number DE93008019. Source: OSTI; NTIS.

In this report we outline an implementation technique for arrays in SISAL 2.0 as well as in other parallel programming languages. To preserve the efficiency of array access required for parallel systems with either shared memory or distributed memory, we rely on organizational opportunities first observed while working through the design of SISAL 2.0. We had three goals in the redesign of array facilities for SISAL. First, the currently implemented version of SISAL, 1.2, has some redundancy among array operations that we wanted to simplify without losing expressive power or convenience. Second, experience showed us that we need true multi-dimensional arrays (as well as arrays of arrays). Third, other languages with arrays define operations analogous to those on scalars that work element-by-element on array operands, so we defined this expressive power for SISAL arrays. The distribution of array objects among the processor-memory pairs of distributed-memory parallel systems is a subject of significant current study. The development of explicit distribution techniques embedded in programming languages is exemplified by PCF Fortran. Fortran D uses programmer-defined declarations as well as compiler optimization to improve efficiency. Automatic data alignment is the goal of several projects. Another major group of research projects aims to preserve the illusion of a single shared memory on distributed-memory multiprocessors. These distributed shared-memory systems may be tied to programming languages or may be operating system based. Different systems implement versions of coherence, but most keep track of fixed-size pages containing shared data. Our goal is to provide an efficient implementation that is similar for both shared-memory and distributed-memory parallel systems.

28113 (CONF-9210270–, pp. 223-241) **FOL: An object oriented extension to the SISAL language (extended abstract).** Pantel, M. (IRIT/ENSEEIHT, Toulouse (FR)); Gandriau, M.; Salle, P. Lawrence Livermore National Lab., CA (United States). Dec 1992. From 2. sisal users' conference; San Diego, CA (United States); 4-5 Oct 1992. In *Proceedings of the second SISAL users' conference.* 273p. Order Number DE93008019. Source: OSTI; NTIS.

This paper describes an improvement of the reusability model of the SISAL language. The study of the object oriented paradigm limits leads us to propose several extensions promoting a higher reusability scheme. The paper contains the description of the FOL language and of its translator to SISAL as well as insights in our future work on impure effects.

28114 (CONF-9210270–, pp. 243-255) **Twine: A portable, extensible SISAL execution kernel.** Miller, P.J. Lawrence Livermore National Lab., CA (United States). Dec 1992. DOE Contract W-7405-ENG-48. From 2. sisal users' conference; San Diego, CA (United States); 4-5 Oct 1992. In *Proceedings of the second SISAL users' conference.* 273p. Order Number DE93008019. Source: OSTI; NTIS.

Functional programs are very much like black boxes - inputs are applied to programs that produce outputs. We need tools to help us peer into these boxes and find out what's going on. Some of the traditional tools programmers use to augment programs (print statements, monitors, histogrammers) are impossible to describe in the functional paradigm. This paper presents ways to instrument a computational engine that is simulating a functional execution. The TWINE engine executes a serialized, complied version of Sisal's intermediate form IF1. The tool generation environment compiled allows moderately sophisticated users to write packages that can instrument running Sisal programs. The engine provides a clean abstraction of the execution, so the tool writer does not have to worry as much about the internal execution of the program.The engine talks to tools through an event-driven interface. This paper gives an overview as to how the engine works, and how Sisal codes are compiled for it. The paper concludes with an example which constructs an instrument which monitors array sizes.

28115 (CONF-9210270–, pp. 257-270) **Investigating the memory performance of the optimising SISAL compiler.** Engelhardt, D. (Univ. of Adelaide (AU)); Wendelborn, A. Lawrence Livermore National Lab., CA (United States). Dec 1992. From 2. sisal users' conference; San Diego, CA (United States); 4-5 Oct 1992. In *Proceedings of the second SISAL users' conference.* 273p. Order Number DE93008019. Source: OSTI; NTIS.

This paper describes additions made to the runtime system of OSC v12.7 which allow details of memory usage to be collected at discrete time steps. We also discuss experiments we have carried out with the aid of this tool, and describe how these experiments have helped us gain a better understanding of the memory characteristics of OSC and its optimisations. We further show how this understanding has enabled us to hand-optimise the memory performance of our programs to produce optimal memory performance.

28116 (CONF-9305151–, pp. 15, Paper 1) **A prototype distributed audit system using network management protocols.** Banning, D.L. (SPARTA, Inc., Torrance, CA (US)). USDOE Office of Administration and Management, Washington, DC (United States). [1993]. From 15. computer security group training conference: mission possible - connected and protected; Albuquerque, NM (United States); 3-6 May 1993. In *Fifteenth Department of Energy Computer Security Group training conference: Mission possible: Connected and protected.* 244p. Order Number DE93011853. Source: OSTI; NTIS.

Security auditing systems are used to detect and assess unauthorized or abusive system usage. Historically, security audits were

confined to a single computer system. Recent work examines ways of extending auditing to include heterogeneous groups of computers (distributed systems). This paper describes the design and prototype development of a Distributed Audit System (DAS) which was developed with funding received from Lawrence Livermore Laboratory and through the Master's thesis effort performed by the author at California State University, Long Beach. The DAS uses network management protocols to provide collection, transfer, and control of audit data on distributed, heterogeneous hosts. 6 refs.

28117 (CONF-9305151–, pp. 14, Paper 2) **Using UNIX system auditing for detecting network intrusions.** Christensen, M.J. (Lawrence Livermore National Lab., CA (US)). USDOE Office of Administration and Management, Washington, DC (United States). [1993]. DOE Contract W-7405-ENG-48. From 15. computer security group training conference: mission possible - connected and protected; Albuquerque, NM (United States); 3-6 May 1993. In *Fifteenth Department of Energy Computer Security Group training conference: Mission possible: Connected and protected.* 244p. Order Number DE93011853. Source: OSTI; NTIS.

Intrusion Detection Systems (IDSs) are designed to detect actions of individuals who use computer resources without authorization as well as legitimate users who exceed their privileges. Although significant progress is being made in IDS research, at present IDSs are no panacea. This paper describes a different approach, namely a decision aiding approach to intrusion detection. The introduction of a decision tree represents the logical steps necessary to distinguish and identify different types of attacks. This tool, the Intrusion Decision Aiding Tool (IDAT), utilizes IDS-based attack models and standard Unix audit data. Since attacks have certain characteristics and are based on already developed signature attack models, experienced and knowledgeable Unix system administrators know what to look for in system audit logs to determine if a system has been attacked. Others, however, are usually less able to recognize common signatures of unauthorized access. Users can traverse the tree using available audit data displayed by IDAT and general knowledge they possess to reach a conclusion regarding suspicious activity. IDAT is an easy-to-use window based application that gathers, analyzes, and displays pertinent system data according to Unix attack characteristics. IDAT offers a more practical approach and allows the user to make an informed decision regarding suspicious activity. 21 refs., 8 figs.

28118 (CONF-9305151–, pp. 18, Paper 3) **The potential role of quantum cryptography for secure private communications.** Feingold, R. (Lawrence Livermore National Lab., CA (US)). USDOE Office of Administration and Management, Washington, DC (United States). [1993]. DOE Contract W-7405-ENG-48. From 15. computer security group training conference: mission possible - connected and protected; Albuquerque, NM (United States); 3-6 May 1993. In *Fifteenth Department of Energy Computer Security Group training conference: Mission possible: Connected and protected.* 244p. Order Number DE93011853. Source: OSTI; NTIS.

This paper examines progress in quantum cryptography, its future potential, and explores how this new methodology might mesh with the increasing needs for secure private communications. From the perspective of a computer security specialist, this paper investigates and fosters understanding of these topics. The intended audience of management and technical people interested in computer and network security requires no special background or expertise. Ingenious research in quantum physics has created a bold possibility for the future of cryptography. Current practical cryptographic technologies attempt to assure privacy by means of secret keys or one-way mathematical functions-those functions that even enormous expenditures of time and computational resources cannot invert. However, an attacker may compromise these methods through discovery of the secret keys, sophisticated as well as brute force cryptanalytic attacks, computationally feasible inversion of the mathematical functions, or by intercepting, altering, and then retransmitting the messages. Remarkably, in the last few years researchers have proposed combining quantum physical properties with tangible apparatus to implement a new cryptographic methodology-quantum cryptography. The latter offers the potential of assuring privacy through fundamental physical laws. An eavesdropper with unlimited computing power could not compromise quantum cryptographic transactions. Further, correspondents would know immediately whether or not an eavesdropper was monitoring their communications. 30 refs., 3 figs.

28119 (CONF-9305151–, pp. 11, Paper 4) **The steps to SATURN: Security planning.** Harris, D.D. (Allied-Signal Aerospace Co., Kansas City, MO (US)). USDOE Office of Administration and Management, Washington, DC (United States). [1993]. From 15. computer security group training conference: mission possible - connected and protected; Albuquerque, NM (United States); 3-6 May 1993. In *Fifteenth Department of Energy Computer Security Group training conference: Mission possible: Connected and protected.* 244p. Order Number DE93011853. Source: OSTI; NTIS.

To better serve its customers, both external and internal, the DOE Kansas City Plant (KCP) has initiated a project to create an enterprise network for unclassified data. This paper will focus on the security aspects of the enterprise data network and will also present an overview of the current and planned network at the KCP. The first part of the paper provides the background information for the rest of the presentation. It addresses the question "Why a network?" and then describes some of the challenges met in developing the KCP enterprise data network to its current state. The process of developing security guidelines and policies for the enterprise network comprises the major portion of this paper. It presents a rationale for requiring security in an unclassified environment, then describes how KCP associates developed a set of guidelines and policies for users of the network. After presentation of this paper a panel of KCP associates will answer questions about the process and also quiz attendees about their own networks. The panel hopes that this question and answer session will allow further improvements in the process as well as in the resulting updated guidelines and policies. 1 fig.

28120 (CONF-9305151–, pp. 25, Paper 5) **Addressing the insider threat.** Hochberg, J.C. (Los Alamos National Lab., NM (US)); Jackson, K.A.; McClary, J.F.; Simmonds, D.D. USDOE Office of Administration and Management, Washington, DC (United States). [1993]. DOE Contract W-7405-ENG-36. From 15. computer security group training conference: mission possible - connected and protected; Albuquerque, NM (United States); 3-6 May 1993. In *Fifteenth Department of Energy Computer Security Group training conference: Mission possible: Connected and protected.* 244p. Order Number DE93011853. Source: OSTI; NTIS.

Computers have come to play a major role in the processing of information vital to our national security. As society grows more dependent on computers, it also becomes more vulnerable to their misuse. Misuse may be accidental, or may occur deliberately for purposes of personal gain, espionage, terrorism, or revenge. While it is difficult to obtain exact statistics on computer misuse, clearly it is growing. It is also clear that insiders – authorized system users – are responsible for most of this increase. Unfortunately, their insider status gives them a greater potential for harm. This paper takes an asset-based approach to the insider threat. The authors begin by characterizing the insider and the threat posed by variously motivated insiders. Next, the asset of concern is characterized: computerized information of strategic or economic value. Four general ways in which computerized information is vulnerable to adversary action by the insider are discussed: disclosure, violation of integrity, denial of service, and unauthorized use of resources. Finally, the authors look at three general remedies for these vulnerabilities. The first is formality of operations, such as training, personnel screening, and configuration management. The second is the institution of automated safeguards, such as single-use passwords, encryption, and biometric devices. The third is the development of automated systems that collect and analyze system and user data to look for signs of misuse. 37 refs.

28121 (CONF-9305151–, pp. 7, Paper 6) **Microcomputer resource inspection/self-inspection program.** Hockett, E.L. Jr. (Oak Ridge Y-12 Plant, TN (US)); Marlow, K.A. USDOE Office of Administration and Management, Washington, DC (United States). [1993]. DOE Contract AC05-84OR21400. From 15. computer security group training conference: mission possible - connected and protected; Albuquerque, NM (United States); 3-6 May 1993. In *Fifteenth Department of Energy Computer Security Group training*

conference: Mission possible: Connected and protected. 244p. Order Number DE93011853. Source: OSTI; NTIS.

A Computer Security Program is not just a concept. It is real action by real people. Under direction of DOE Orders, Martin Marietta Energy Systems, Inc., personnel have developed a Microcomputer Security Program at the Oak Ridge Y-12 Plant that is both effective and sensible. The Computer Security Program at the Y-12 Plant is structured to provide a clear chain of functional responsibility. Additionally, the program allows for effective communication channels to exist from the Computer Security Site Manager/Computer Protection Program Manager to approximately 6000 users. Annually, the Division Computer Security Officer is required to assist the Y-12 Plant Computer Security Officer in performing a formal Microcomputer Security Inspection within his/her division. This article describes the inspection program, including discussions on the inspection schedule, inspection notification, the actual inspection, reporting the results of an inspection, and corrective actions and follow-up.

28122 (CONF-9305151–, pp. 14, Paper 7) **PC security products characteristics to consider.** Krehnke, M.E. (Martin Marietta Energy Systems, Inc., Oak Ridge, TN (US)). USDOE Office of Administration and Management, Washington, DC (United States). [1993]. DOE Contract AC05-84OR21400. From 15. computer security group training conference: mission possible - connected and protected; Albuquerque, NM (United States); 3-6 May 1993. In *Fifteenth Department of Energy Computer Security Group training conference: Mission possible: Connected and protected.* 244p. Order Number DE93011853. Source: OSTI; NTIS.

This paper presents the viewpoint that the appropriate response to increased computer security vulnerability is a multifaceted approach to personal computer (PC) security, incorporating physical security, administrative controls, and technical security measures. One objective of this paper is to make the reader aware of the limitations of PC security products, despite the vast number of products and product options which are now available on the market. Another objective is to emphasize that a product will not provide security if it does not meet the security requirements of the environment in which it will be implemented. Information regarding PC vulnerabilities, the functions and characteristics of PC security products that respond to those vulnerabilities, and ways in which PC security products can be circumvented are presented. 4 refs.

28123 (CONF-9305151–, pp. 18, Paper 8) **An alternative to SneakerNet.** Orrell, S. (EG&G Energy Measurements, Inc., Albuquerque, NM (US)); Ralstin, S. USDOE Office of Administration and Management, Washington, DC (United States). [1993]. From 15. computer security group training conference: mission possible - connected and protected; Albuquerque, NM (United States); 3-6 May 1993. In *Fifteenth Department of Energy Computer Security Group training conference: Mission possible: Connected and protected.* 244p. Order Number DE93011853. Source: OSTI; NTIS.

Information security systems can provide only conditional protection that takes the form of detection and sanction of violations. Design of any computer security system or procedure should recognize that information security violations can only be deterred. Security plans for classified computer systems often specify that only a small percentage of the data processed will be classified. Thus, the bulk of the data on such secure systems is unclassified. This situation requires that some mechanism be provided for moving files to or from the open environment. This has been accomplished by writing selected files to a magnetic medium and carrying it to another system where the files are retrieved. These procedures have often been developed informally and ad hoc to a specific transfer requirement. This media transport process, referred to as sneakernet, often is manually logged and controlled only by administrative procedures. While sneakernets may isolate secure systems from direct attacks, other security concerns remain. This paper examines the security concerns associated with transfers of unclassified files between security environments and develops a set of criteria which can be used in evaluating the security of any system or procedure for that purpose. Methods for bi-directional unclassified file transfer between secure and open environments could range from completely manual to fully automated. The criteria developed are intended to be generic and to apply to any system for the purpose, existing or proposed.

28124 (CONF-9305151–, pp. 10, Paper 10) **Verification of security controls on classified systems.** Pees, J.B. (ManTech Strategic Associates, Ltd., Fairfax, VA (US)). USDOE Office of Administration and Management, Washington, DC (United States). [1993]. From 15. computer security group training conference: mission possible - connected and protected; Albuquerque, NM (United States); 3-6 May 1993. In *Fifteenth Department of Energy Computer Security Group training conference: Mission possible: Connected and protected.* 244p. Order Number DE93011853. Source: OSTI; NTIS.

Verification of security controls on classified systems is an essential function that must be accomplished prior to initial operation and at regular intervals throughout the system life-cycle. Security controls are not only applied at different stages during the system life-cycle, including development, testing, and operation, but are applied at different levels, including the application, system, and network levels. This article addresses verification of controls at the application, system, and network level. The proper functioning of security controls must be verified to ensure that classified information is adequately protected once the system is operational. Verification activities are performed by several types of individuals, each with allied but distinct responsibilities. Developers, certifying officials, accrediting authorities, and inspectors all perform verification functions. Of primary interest are the verification activities used during the certification and inspection processes. Although the purpose of each process is different, the methods used to verify security controls are similar. The methods and evaluation tools described can be used by either certifying officials or inspectors to verify controls and assess the level of protection provided by those controls.

28125 (CONF-9305151–, pp. 13, Paper 11) **Kerberos: A UNIX-TCP/IP network authentication system.** Rahe, W.H. (Sandia National Laboratories, Albuquerque, NM (US)); Machin, G.D. USDOE Office of Administration and Management, Washington, DC (United States). [1993]. From 15. computer security group training conference: mission possible - connected and protected; Albuquerque, NM (United States); 3-6 May 1993. In *Fifteenth Department of Energy Computer Security Group training conference: Mission possible: Connected and protected.* 244p. Order Number DE93011853. Source: OSTI; NTIS.

Distributed computing requires security restrictions to limit unauthorized usage of valuable computing resources as well as the privacy and/or integrity of critical corporate and personal information. Reliable authentication is the primary source of all computer security. Resource authorization, accounting, and audit of a distributed computing environment mandate that the authenticity of each customer be unique and well-determined prior to access to any computing resources in the distributed environment. Operating systems based on "UNIX®" have been installed throughout Sandia National Laboratories (SNL) on numerous workstation platforms as well as on the "Central Service" nodes. Authentication of customers on many computer systems is provided by the individual computing resource through the use of "passwords." In the traditional UNIX environment, each computing resource relies on a local authentication/authorization file (frequently/etc/password) for access control. In recognition of the difficulties in multiple authentication, Digital Equipment Corporation (DEC) and International Business Machines (IBM) provided funding for the creation of Project Athena at the Massachusetts Institute of Technology to address distributed computing including security. Kerberos™ is an application developed by Project Athena to provide centralized third-party authentication in a distributed network. Network access control may be provided by Kerberos for each of the computing resources within either a local or remote network. This article further discusses the specifications and applications of Kerberos. 14 refs., 8 figs., 1 tab.

28126 (CONF-9305151–, pp. 19, Paper 12) **Still stalking the wily hacker: A case study of network intrusions from overseas.** Schultz, E.E. (Eugene Schultz and Associates, Livermore, CA (US)); Kuhn, D.R.; Howard, V. USDOE Office of Administration and Management, Washington, DC (United States). [1993]. From

15. computer security group training conference: mission possible - connected and protected; Albuquerque, NM (United States); 3-6 May 1993. In *Fifteenth Department of Energy Computer Security Group training conference: Mission possible: Connected and protected.* 244p. Order Number DE93011853. Source: OSTI; NTIS.

Cliff Stoll helped awaken the American public to the threat of intrusions into US computers from overseas. Stoll's descriptions of intrusions that occurred between 1986 and 1988 are by no means exhaustive accounts of such intrusions; there has been a steady stream of intrusions into US computers since the time of Stoll's accounts. Last year the National Institute of Standards and Technology (NIST) initiated and completed a study of intrusions into US Government computers originating from overseas in 1990. This paper presents the major findings and conclusions from this unclassified study. There was a large number of intrusions into a variety of UNIX and VMS computers connected to the Internet and Milnet. The attacker(s) generally first used a network information center (NIC) to locate computers to attack. Although there were several distinct attack signatures (described in detail in this paper) during three distinct phases of activity, most attack methods focused on exploiting weak passwords, then escalating privilage(s). There were also identifiable attacks routes, although the particular host systems, sites, and/or US agencies and departments involved are withheld. In many cases, the attacker(s) first intruded into an account long enough only to establish that the account could be compromised, then transferred files from that account several weeks later. The success rate of intrusions was low at first, but increased over time. These intrusions lead to numerous "lessons learned." Most fundamentally, the intrusions and other attacks demonstrate the severity of the continued overseas threat upon US computers. Measures that network administrators, system managers, and users could have employed to prevent these and similar network intrusions are discussed in this paper. Better password selection would have deterred more of these attacks than any other measure. 4 refs.

28127 (CONF-9305151–, pp. 9, Paper 13) **Automated information systems security inspection tools.** Smoot-Wood, D.; Seeger, J. USDOE Office of Administration and Management, Washington, DC (United States). [1993]. From 15. computer security group training conference: mission possible - connected and protected; Albuquerque, NM (United States); 3-6 May 1993. In *Fifteenth Department of Energy Computer Security Group training conference: Mission possible: Connected and protected.* 244p. Order Number DE93011853. Source: OSTI; NTIS.

The Office of the Deputy Assistant Secretary for Security Evaluations (SE) inspects computer security programs at the Department of Energy (DOE) Headquarters and field offices to evaluate the status of protection provided to national security interests and program operations involving the use of automated information systems. To support this process, SE has developed automated performance tests, computer software-based tools, and structured methodologies which are an essential element of the computer security inspection topic. This paper describes how these inspection techniques evolved and the benefits derived from their use. 1 fig.

28128 (CONF-9305151–, pp. 8, Paper 14) **The Network Database.** Starcher, A. (Sandia National Laboratories, Albuquerque, NM (US)). USDOE Office of Administration and Management, Washington, DC (United States). [1993]. From 15. computer security group training conference: mission possible - connected and protected; Albuquerque, NM (United States); 3-6 May 1993. In *Fifteenth Department of Energy Computer Security Group training conference: Mission possible: Connected and protected.* 244p. Order Number DE93011853. Source: OSTI; NTIS.

UNIX is an operating system designed on the 'do your own thing' premise with free, open connectivity to files, machines and networks. This has been proven to be a wonderful thing on small, open access systems where everyone knows everyone else and none of the data is even remotely private, much less classified. In the world of large networks and/or secure computing however, the afore mentioned aspects of UNIX that made it initially so attractive, tend to quickly become an administrative nightmare. When Sandia central computing announced it was moving to a UNIX environment, it received a request from existing UNIX users and system administrators at Sandia. They had been involved with UNIX for years before the central site decided to make the move and had been through the headaches and pitfalls of the system. They wanted something that could use to make a sometimes unruly system more manageable. The Network Database is that tool. It is designed to make the potentially chaotic UNIX/networking environment more orderly and much easier to manage. To accomplish this, it uses the Network Naming Conventions as its basis and ensures uniqueness of any of several items that could cause conflict if duplicated.

28129 (CONF-9305151–, pp. 6, Paper 15) **Developing and implementing a software management program.** Tussing, D.D. (Argonne National Lab., IL (US)). USDOE Office of Administration and Management, Washington, DC (United States). [1993]. From 15. computer security group training conference: mission possible - connected and protected; Albuquerque, NM (United States); 3-6 May 1993. In *Fifteenth Department of Energy Computer Security Group training conference: Mission possible: Connected and protected.* 244p. Order Number DE93011853. Source: OSTI; NTIS.

The Department of Energy issued DOE Order 1330.1C in January 1990, for the purpose of "establishing policies and responsibilities for computer software management." The Order was revised in May 1992 to reflect organizational changes and issued as DOE Order 1330.1D. The Order pertains to all DOE elements, including management and operating contracts, and applies to "software proposed for use, under development, and being maintained and used, whether developed in-house, licensed from a vendor, obtained from another organization, or otherwise acquired." Software management and computer protection are tied closely together. Software management must address inventory management, configuration management, and development management. These three areas must address disaster recovery/business continuation, contingency planning, virus detection and control, compliance with license restrictions (individual and network), and other control issues. Individuals charged with computer protection are often, by default, also assigned these responsibilities. Argonne National laboratory (ANL) has adopted a graded methodology to implement a program for software management that will incorporate quality assurance, configuration management, development management, and inventory management into a single program. ANL will take credit for program aspects currently in place and will adopt reasonable practices to implement the remaining areas of the Order. The Software Management Program described here fulfills the DOE order requirements and allows particular divisions the latitude to determine appropriate requirements for software within their divisions. 1 fig.

28130 (CONF-9305151–, pp. 23, Paper 17) **How do you get people to pay attention to computer security?.** Warshawsky, G.S. (Lawrence Livermore National Lab., CA (US)). USDOE Office of Administration and Management, Washington, DC (United States). [1993]. DOE Contract W-7405-ENG-48. From 15. computer security group training conference: mission possible - connected and protected; Albuquerque, NM (United States); 3-6 May 1993. In *Fifteenth Department of Energy Computer Security Group training conference: Mission possible: Connected and protected.* 244p. Order Number DE93011853. Source: OSTI; NTIS.

A Computer Security Education and Awareness Program can reach many people in a variety of ways. The use of attention grabbers can add excitement and interest to your Awareness Program. Create a recognizable character to spread the word about computer security. Make use of Closed Circuit Television (CCTV) and VCR technology to liven up an Education and Awareness Program. Computer Security videos can be shown on CCTV giving many people the opportunity to view them simultaneously. Humor can be used in presentations and in a variety of publications. Develop an Outreach Program that can provide computer security professionals with a positive voice in the community. Invest in the future by providing computer security awareness to children and adults today. This session will share some of the successful attention grabbing techniques and strategies used in the Lawrence Livermore National Laboratory's Computer Security Continuing Education and Awareness Program.

28131 (CONF-9305151–, pp. 15, Paper 18) **Securing electronic mail: The risks and future of electronic mail.** Weeber, S.A. (Lawrence Livermore National Lab., CA (US)). USDOE Office of Administration and Management, Washington, DC (United States). [1993]. DOE Contract W-7405-ENG-48. From 15. computer security group training conference: mission possible - connected and protected; Albuquerque, NM (United States); 3-6 May 1993. In *Fifteenth Department of Energy Computer Security Group training conference: Mission possible: Connected and protected.* 244p. Order Number DE93011853. Source: OSTI; NTIS.

The network explosion of the past decade has significantly affected how many people conduct day to day work. Network services such as electronic mail, file transfer, and network newsgroups are increasingly relied upon to collect and distribute information. Unfortunately, few of the network services in use today were designed with the security issues of large heterogeneous networks in mind. In particular, electronic mail, although heavily relied upon, is notoriously insecure. Messages can be forged, snooped, and even altered by users with only a moderate level of system proficiency. The level of trust that can be assigned at present to these services needs to be carefully considered. In the past few years, standards and tools have begun to appear addressing the security concerns of electronic mail. Principal among these are RFC's 1421, 1422, 1423, and 1424, which propose Internet standards in the areas of message encipherment, key management, and algorithms for privacy enhanced mail (PEM). Additionally, three PEM systems, offering varying levels of compliance with the PEM RFC'S, have also recently emerged: PGP, RIPEM, and TIS/PEM. This paper addresses the motivations and requirements for more secure electronic mail, and evaluates the suitability of the currently available PEM systems. 13 refs., 3 figs.

28132 (CONF-9305151–, pp. 10, Paper 16) **UNICOS security testing.** Vandevender, W.H. (Sandia National Laboratories, Albuquerque, NM (US)). USDOE Office of Administration and Management, Washington, DC (United States). [1993]. From 15. computer security group training conference: mission possible - connected and protected; Albuquerque, NM (United States); 3-6 May 1993. In *Fifteenth Department of Energy Computer Security Group training conference: Mission possible: Connected and protected.* 244p. Order Number DE93011853. Source: OSTI; NTIS.

Developing security plans and supporting security tests is a very important part of the Department of Energy accreditation process. This paper will discuss the general testing methodology that was used to achieve DOE accreditation of the Secure UNICOS environment at Sandia National Laboratories (NM). In addition, some specific security testing procedures, tests and problem areas will be described. 2 figs., 1 tab.

28133 (CONF-9305207–1) **Hybrid pattern recognition system capable of self-modification.** Glover, C.W. (Oak Ridge National Lab., TN (United States)); Oblow, E.M.; Rao, N.S.V. Oak Ridge National Lab., TN (United States). [1993]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Grant: INF-90-015. From 2. international conference on information and knowledge management; Washington, DC (United States); 1-5 May 1993. Order Number DE93015442. Source: OSTI; NTIS; GPO Dep.

Systems capable of recognizing and learning two-dimensional patterns can be used in imaging systems and robotic perception systems. The symbolic and neuromorphic methods for pattern processing problems of this type are complementary in character. We present a hybrid system that utilizes components of symbolic and neuromorphic type; we employ two hybrid components that simultaneously operate up on the same data to produce hypotheses about the data. To resolve the potential conflicts in these hypotheses, we propose a method that learns a combination rule based on a set of examples. We employ the method of empirical risk minimization and does not require knowledge about the error probability distributions of the modules. We are building a prototype system to recognize control panels using a vision system.

28134 (CONF-930781–1) **Decentralized control of uncertain systems via sensitivity models.** Schoenwald, D.A. (Oak Ridge National Lab., TN (United States)); Oezguener, U. Oak Ridge National Lab., TN (United States). [1993]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 12. International Federation of Automatic Control (IFAC) world congress; Sydney (Australia); 19-23 Jul 1993. Order Number DE93012963. Source: OSTI; NTIS; GPO Dep.

In this paper, we present a decentralized strategy for optimal control of interconnected systems exhibiting parametric uncertainty. First, we demonstrate that sensitivity models for linear interconnected systems can be generated at each subsystem using only locally available information. Second, we present an optimal control law that incorporates sensitivity functions in the feedback path. The control scheme is completely decentralized and is proposed as a means of making the closed loop system less sensitive to parameter deviations. Finally, we give an example of an interconnected system and show how this control strategy is implemented.

28135 (CONF-9308124–1) **Eye-gaze and intent: Application in 3D interface control.** Schryver, J.C. (Oak Ridge National Lab., TN (United States)); Goldberg, J.H. Oak Ridge National Lab., TN (United States). [1993]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 5. international conference on human-computer interaction; Orlando, FL (United States); 8-13 Aug 1993. Order Number DE93015210. Source: OSTI; NTIS; GPO Dep.

Computer interface control is typically accomplished with an input "device" such as keyboard, mouse, trackball, etc. An input device translates a users input actions, such as mouse clicks and key presses, into appropriate computer commands. To control the interface, the user must first convert intent into the syntax of the input device. A more natural means of computer control is possible when the computer can directly infer user intent, without need of intervening input devices. We describe an application of eye-gaze-contingent control of an interactive three-dimensional (3D) user interface. A salient feature of the user interface is natural input, with a heightened impression of controlling the computer directly by the mind. With this interface, input of rotation and translation are intuitive, whereas other abstract features, such as zoom, are more problematic to match with user intent. This paper describes successes with implementation to date, and ongoing efforts to develop a more sophisticated intent inferencing methodology.

28136 (CRN–92-22) **Multi-dimensional analysis of high resolution γ-ray data.** Flibotte, S. (Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires); Huettmeier, U.J.; France, G. de; Haas B.; Romain, P.; Theisen, Ch.; Vivien, J.P.; Zen, J. Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires. [1992]. [17p.] Order Number DE93631732. Source: OSTI; NTIS (US Sales Only); INIS.

Submitted to Nuclear Instruments and Methods in Physics Research, A (NL).

A new generation of high resolution γ-ray spectrometers capable of recording high-fold coincidence events with a large efficiency will soon be available. Algorithms are developed to analyze high-fold γ-ray coincidences. As a contribution to the software development associated with the EUROGAM spectrometer, the performances of computer codes designed to select multi-dimensional gates from 3-, 4- and 5-fold coincidence databases were tested. The tests were performed on events generated with a Monte Carlo simulation and also on real experimental triple data recorded with the 8π spectrometer and with a preliminary version of the EUROGAM array. (R.P.) 14 refs.; 3 figs.; 3 tabs.

28137 (DOE/ER–0587) **Requirements for supercomputing in energy research: The transition to massively parallel computing.** USDOE Office of Energy Research, Washington, DC (United States). Office of Scientific Computing. Feb 1993. 73p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93012376. Source: OSTI; NTIS; GPO Dep.

This report discusses: The emergence of a practical path to TeraFlop computing and beyond; requirements of energy research programs at DOE; implementation: supercomputer production computing environment on massively parallel computers; and implementation: user transition to massively parallel computing.

28138 (DOE/ER/25015–T1) **Computation and graphics in mathematical research: Progress report, September 15, 1992–September 15, 1993.** Hoffman, D.A.; Spruck, J. Massachusetts

Univ., Amherst, MA (United States). Jun 1993. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-86ER25015. Order Number DE93016512. Source: OSTI; NTIS; GPO Dep.

Current research is described on: grain boundaries and dislocations in compound polymers, boundary value problems for hypersurfaces constant Gaussian curvature, and discrete computational geometry. 19 refs, 4 figs.

28139 (DOE/ER/25133–1) **Database computing for the SSC: Progress report.** Grossman, R. Illinois Univ., Chicago, IL (United States). Jun 1993. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-92ER25133. Order Number DE93017317. Source: OSTI; NTIS; GPO Dep.

This is a progress report for the Grant "The PASS Project: Database computing for the SSC" for the period September 1, 1993–May 30, 1993. The number of the grant is ER25133; the institution is the University of Illinois at Chicago; and the principal investigator is Robert Grossman. The PASS Project is ware tools for making numerically intensive queries on very large amounts of data, especially high energy physics data. Approach is to view the analysis of such data as an appropriate query on a persistent object store.

28140 (DOE/ER/40374–70) **An optimized formulation for Deprit-type Lie transformations of Taylor maps for symplectic systems.** Shi, Jicong (Houston Univ., TX (United States). Dept. of Physics); Yan, Yiton T. Houston Univ., TX (United States). Dept. of Physics; Superconducting Super Collider Lab., Dallas, TX (United States). [1993]. 2p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-87ER40374 ;AC35-89ER40486. (CONF-930511–95: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014886. Source: OSTI; NTIS; INIS; GPO Dep.

An optimized iterative formulation is presented for directly transforming a Taylor map of a symplectic system into a Deprit-type Lie transformation, which is a composition of a linear transfer matrix and a single Lie transformation, to an arbitrary order.

28141 (DOE/ER/61034–2) **Chaos and microbial systems: Final project report, July 1989–July 1992.** Kot, M. Washington Univ., Seattle, WA (United States). Dept. of Applied Mathematics. Oct 1992. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG06-90ER61034. Order Number DE93016814. Source: OSTI; NTIS; GPO Dep.

The field of nonlinear dynamics has generated a variety of new techniques for identifying order in seemingly chaotic systems. These techniques have led to new insights for several ecological and epidemiological systems, most notably childhood disease epidemics. To better test the efficacy and relevance of these new techniques to population biology research with two components namely a mathematical analysis of some simple microbial models with chaotic dynamics; and experimental (chemostat) population studies to evaluate the accuracy of these models. I have completed a thorough analysis of the forced double-Monod model and of the phase-locking route to chaos that it exhibits. I have also analyzed a simpler pulsed system with mass action kinetics and a period-doubling route to chaos. This research also motivated detailed analyses of discrete-time predator-prey and dispersal models, and a fast new method for computing fractal dimension. My colleagues and I have assembled a complete laboratory system to determine the appropriateness of the forced double-Monod model. We have tested assays for concentration and density and have performed a variety of diagnostic tests on this system. We have measured growth parameters for bacteria and for protozoa in chemostat.

28142 (ENEA-RT-ENERG–91-06) **Mathematical operators: Solutions for four different problems.** Lorenzoni, G. ENEA, Casaccia (Italy). Area Energetica. Dec 1991. 30p. (In Italian). (RT/ENERG–91-06). Order Number DE93799277. Source: OSTI; NTIS (US Sales Only); INIS.

A random numbers generator, based on a new theory, is described. Perfect casuality and absolute assurance against repetitivity for any generation length are the main features of this generator. The generator was used to develop: a new FORTRAN program for text cryptation; a new solution of a combinatorial problem; and a FORTRAN program for linear optimization, using a simplex method, of general applicability and easy implementation.

28143 (ENEA-RT-GEN–91-01) **Project evaluation and monitoring system (SVEN): Multi-criteria algorithm.** Bellacicco, A.; Poma, C.; Vignola, P. ENEA, Rome (Italy). Dec 1991. 33p. (In Italian). (RT/GEN–91-01). Order Number DE93799295. Source: OSTI; NTIS (US Sales Only); INIS.

In this report a new approach to project evaluation, belonging to the wide class of multi-criteria (socio-economic and environmental aspects) preference modelling, is presented. The novelty of the proposal is the introduction of the concepts of targets and benefits and the dynamic use of the algorithm. In this way, the proposed methodology is able to support the project manager in the evaluation of the project 'ex ante', on going, and ex post. The notion of project is new in the operational research context. The target of the proposed notion is different from the usual targets based on the optimization of some given objective functions.

28144 (ENEA-RT-INN–92-24) **Stabilizing periodic orbits in chaotic neural dynamics.** Tondinelli, L. ENEA, Casaccia (Italy). Dec 1992. 23p. (RT/INN–92-24). Order Number DE93799196. Source: OSTI; NTIS (US Sales Only).

Chaotic behavior occurs normally in biological systems, and the appearance of chaos in mathematical simulations must be considered significant. Chaotic states of neuron activity are associated with higher level cognitive processes such as generalization and abstraction. The generalization procedure performed by chaotic attractors is represented by storing a topological image of the whole class of different dynamical behaviors (from different initial conditions) which possess different metrical characteristics but have the same topological invariants. Given a chaotic attractor, information is contained in topological invariants, as, e.g., in closures of the set of its unstable periodic orbits. A method for the stabilization of a selected periodic orbit is the small periodic variation of a system parameter, which can be obtained via the coupling of two physical levels: synaptical transmission and oscillating chemical reactions.

28145 (ENEA-RT-INN–92-25) **There is future for present generation of artificial neural networks.** Tondinelli, L. ENEA, Casaccia (Italy). Area Nucleare. Dec 1992. 20p. (RT/INN–92-25). Order Number DE93799220. Source: OSTI; NTIS (US Sales Only).

This paper suggests reasons to explain why there isn't any future for the present generation of Artificial Neural Networks (ANN's). ANN's have a long history, starting from the mythical paper of McCulloch & Pitts in 1943. Until now, only little has changed in the substance of ANN modeling. They consist of a set of active elements, topologically connected by a matrix of weighted links. The weights variation is the equivalent of 'learning', and the memory is distributed on the entire set of weights. The main property generally used is the capability of an ANN to construct, in its state space, a set of basins of attraction, each corresponding to a learned pattern. Starting from an initial point in the basin, the ANN dynamics falls in the corresponding attractor. The same model has been also used for the simulation of some aspects of neurophysiological experiments; but it is precisely in this field that suspect is born concerning the usefulness and adequacy of such a paradigm. The definition of an ANN architecture for a specific problem is not unique and often requires considerable skill and (why not?) serendipity. Normally, existing literature refers to zero-dimensional ANN's, considering only the topological aspect of the connection matrix, where the incoming information is stored statically (connection weights) in a distributed manner. Evidence is mounting that living neurons possess further properties than a simple binary decision device (stochasticity, temporality, non-linearity, three-dimensionality) which can be included in artificial neurons.

28146 (ESTSC–000154CYYMP02) **KIVA2 92: 2d & 3d Reactive Flows With Fuel Sprays.** Amsden, A.A. (Los Alamos National Lab., NM (United States)); O'Rourke, P.J.; Butler, T.D. Los Alamos National Lab., NM (United States). 27 Mar 1992. Sponsored by USDOE, Washington, DC (United States). Source: ESTSC.

Description: CRAY Y-MP; CTSS and UNICOS; FORTRAN 77; 1 3.5 Diskette. KIVA2 92 uses Cray vectorization statements. Several SLATEC3.1 and LINPACK routines are called. These routines are

provided. KIVA2 92 also calls some CTSS system routines and LANL-specific graphics routines. These routines are not provided but are described at the end of the FORTRAN source. This version corrects errors found in the earlier version, has enhanced portability, more robustness, better accuracy, greater speed, added fuels and corrected/expanded descriptions.

KIVA2 92 solves the equations of transient, two and three-dimensional, chemically reactive fluid flow with sprays. The KIVA2 92 equations and numerical solution procedure are very general and can be applied to laminar or turbulent flows, subsonic or supersonic flows, and single-phase or dispersed two-phase flows. Arbitrary numbers of chemical species and reactions are allowed. A stochastic particle method is used to calculate evaporating liquid sprays, including the effects of droplet collisions and aerodynamic breakups. Although the initial and boundary conditions and mesh generation were written for internal combustion energy calculations, the logic for these specifications can be easily modified for a variety of other applications.

28147 (ESTSC–000154CYYMP03) **KIVA3: A KIVA Program With Block-Structured Mesh for Complex Geometries.** Amsden, A.A. (Los Alamos National Lab., NM (United States)). Los Alamos National Lab., NM (United States). 1 Mar 1993. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Source: ESTSC.

Description: CRAY Y-MP; UNICOS VERSION 6.1.6; Cray Fortran 77 VERSION 5.0.4.12; 1 3.5 Diskette. Source code requires UPDATE to generate a compile file. Linear system solver, such as in LINPACK, is required for equilibrium chemistry solver. Several calls are made to run-time libraries. Graphics postprocessor requires primitives for point plotting and vector drawing, along with character string conversion for plot labels. Source was compiled on a CRAY Y-MP8/864.

KIVA3 is a computer program for the numerical calculation of transient, two and three-dimensional, chemically reactive flows with sprays. It is an extension of the earlier KIVA2, and uses the same numerical solution procedure and solves the same set of equations. KIVA3 differs in that it uses a block-structured mesh with connectivity defined through indirect addressing. The departure from a single rectangular structure in logical space allows complex geometries to be modeled with significantly greater efficiency because large regions of deactivated cells are no longer necessary. Cell-face boundary conditions permit greater flexibility and simplification in the application of boundary conditions.

28148 (ESTSC–000171IPCAT02) **ADASAGE4.02-ALYSIS: Ada Application Development System.** Stewart, K. (EG and G Idaho Inc., Idaho Falls, ID (United States)); Russell, K. EG and G Idaho, Inc., Idaho Falls, ID (United States). 1 Jul 1992. Sponsored by USDOE, Washington, DC (United States); Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Department of Defense, Washington, DC (United States). Source: ESTSC.

Description: IBM PC/AT; DOS; ADA; 13 3.5 Diskettes. The Alsys Ada 4.33 compiler is required.

ADASAGE is an application development system designed to facilitate rapid and professional construction of applications written in Ada on microcomputers. Applications may vary in size from small to large multiprogram systems. ADASAGE consists of a collection of re-usable libraries for database management and form and report processing utilities having the following capabilities: basic universal type and function definitions; sequential file input/output; terminal and file input/output; DOS system command execution; data movement and fill; string manipulation; math libraries; bit manipulation; a relational database utility; data validation; menu form and window procedures; report generation; sort/merge, time, and date functions; sound production; editing; and index rebuilding. These capabilities are integrated to allow the development of an efficient system. As an application is designed and developed, ADASAGE capabilities are selected and included along with any requirements unique to that application.

28149 (ESTSC–000171IPCAT03) **ADASAGE4.02-MERIDIAN: Ada Application Development System.** Stewart, K. (EG and G Idaho, Idaho Falls, ID (United States)); Russell, K. EG and G Idaho, Inc., Idaho Falls, ID (United States). 10 Jul 1992. Sponsored by USDOE, Washington, DC (United States); Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Department of Defense, Washington, DC (United States). Source: ESTSC.

Description: IBM PC/AT; DOS; ADA; 10 3.5 Diskettes. The ADASAGE reference documents are written in ARC format and, when extracted, must be printed with WORDPERFECT.

ADASAGE is an application development system designed to facilitate rapid and professional construction of applications written in Ada on microcomputers. Applications may vary in size from small to large multiprogram systems. ADASAGE consists of a collection of re-usable libraries for database management and form and report processing utilities having the following capabilities: basic universal type and function definitions; sequential file input/output; terminal and file input/output; DOS system command execution; data movement and fill; string manipulation; math libraries; bit manipulation; a relational database utility; data validation; menu form and window procedures; report generation; sort/merge, time, and date functions; sound production; editing; and index rebuilding. These capabilities are integrated to allow the development of an efficient system. As an application is designed and developed, ADASAGE capabilities are selected and included along with any requirements unique to that application.

28150 (ESTSC–000337I036000) **PDQ7: 1,2 or 3-d few-gp diffusion depletion.** Wagner, R.J. (EG and G Idaho, Idaho Falls, ID (United States)); Brown, A.W. Bettis Atomic Power Lab., Pittsburgh, PA (United States). 1 Dec 1982. Sponsored by USDOE, Washington, DC (United States). (NESC–275). Source: ESTSC.

Description: IBM360; OS/MVT (IBM360); OS/MVS (IBM30xxFORTRAN IV and COMPASS; 1 Mag Tape.

The PDQ series of programs is designed to solve the neutron diffusion-depletion problem in one, two or three dimensions. The three-dimensional spatial calculation may be either explicit or discontinuous trial function synthesis. Up to five lethargy groups are permitted. Adjoint, fixed source, one iteration, additive fixed source, eigenvalue, and boundary value calculations may be performed. The programs utilize the HARMONY system for time-dependent representation of cross section variation and generalized depletion chain solutions. Geometries available include rectangular, cylindrical, spherical, and hexagonal. All allow variable mesh in all dimensions. Various control searches as well as temperature and xenon feedback are provided.

28151 (ESTSC–000515I036000) **PHROG: Multi-gp Constant & Fast Spectra Calc.** Curtis, R.L. (EG and G Idaho Inc., Idaho Falls, ID (United States)); Singer, G.L.; Wheeler, F.J.; Grimesey, R.A. EG and G Idaho, Inc., Idaho Falls, ID (United States). 1 Dec 1971. Sponsored by USDOE, Washington, DC (United States). (NESC–520). Source: RADIATION SHIELDING INFORMATION CENTER.

Description: IBM360; OS/360; FORTRAN IV; 1 Mag Tape.

PHROG generates energy dependent fast neutron spectra and associated multigroup cross section data suitable for use in diffusion and transport theory reactor design analysis. The solution utilizes 68 equal lethargy groups of cross section, source, and leakage data over an energy range extending from 10 MeV to 0.414 eV. These data are then coalesced into broad group form using the fluxes and currents as weighting functions.

28152 (ESTSC–000574IBMPC00) **RISKIND: Radiological Risk Assessment Code for Spent Nuclear Fuel Transportation.** Chen, S.Y. (Argonne National Lab., IL (United States)); LePoire, D.J.; Yuan, Y.C.; Rothman, R. Argonne National Lab., IL (United States). 1 Feb 1993. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. Source: ESTSC; As is due to no source code being provided.

Description: IBM PC; DOS; Lahey FORTRAN (70%) Microsoft BASIC (30%); 1 3.5 Diskette. Input data files *.INP, output data files *.OUT, installation batch file INSTALL.BAT, database files *.DAT. DUE TO NO SOURCE CODE RELEASED AS-IS.

RISKIND is a computer code system for calculating the radiological consequences and health risks to individuals from the transportation of spent nuclear fuel.

28153 (ESTSC–000587IBMPC00) **BARS/SSC/SPHINX: BARS Bibliographic Data Retrieval System.** Herrmann, W. (Sandia National Labs., Albuquerque, NM (United States)). Sandia National Labs., Albuquerque, NM (United States). 6 Jun 1993. Sponsored by USDOE, Washington, DC (United States). Source: ESTSC.

Description: IBM PC; DOS version 2.2. or higher.; askSam; 2 5.25 Diskettes. Data files must carry the extension .ASK. BARS requires the use of the askSam database program, of which a read-only runtime version is included under license from askSam Systems, SeaSide Software, Inc. PO Box 1428, Perry FL, 32347 USA. Distribution is via self-extracting files compressed using PKARC under license from PKWARE Inc, 7545 North Port Washington Rd., Glendale WI, 53217, USA. DOES NOT CONTAIN SOURCE CODE.

BARS is a program which allows retrieval of information from suitable bibliographic databases. Two databases are included, SSC and SPHINX, which together list bibliographic information for some 12,000 references related to the fields of shoch compression of condensed media, high rate deformation of solids, and detonation.

28154 (ESTSC–000588C017600) **GSM: Columbia Plateau Geologic Site Simulation.** Golis, M.J. (Battelle Columbus Division, OH (United States)). Battelle, Columbus, OH (United States). 1 Jun 1984. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-83CH10140. (NESC–9845). Source: ESTSC.

Description: CDC CYBER176; NOS 1.4 (CDC CYBER176); NOS 2.5.ANSI FORTRAN X3.9-1978; 1 Mag Tape.

GSM is a Monte Carlo simulation program for tracking the future evolution of a repository site over periods of up to several million years. Phenomena included in the model that potentially can affect the site over such periods are: climatic changes, glaciation, deformation, geomorphic events, magmatic events, meteorite impact, sea-level fluctuations, shaft seal failure, basement faulting, and undetected features. Interrelationships among phenomena are modeled, and the effects of changes on ground-water flow are followed using a simplified network model of the ground-water system in a two-dimensional cross-section of the study area. The model is specific to a potential repository site in the Pasco Basin area of the Columbia Plateau. The ground water portion of the code is two-dimensional and is based on a specific conceptualization of the hydrology in the region surrounding the Pasco Basin. The probabilistic nature of the model enables it to be used to evaluate whether a potential site meets any probabilistic regulatory standards such as those that have been issued by the Environmental Protection Agency. Two auxiliary interactive programs to process input and output, respectively, are included. The Input Module is executed prior to the simulation to 1) generate a set of unformatted data files for first-time simulation access; 2) change any or all input parameter values from the previous simulation; or 3) generate listings of input parameter values. The Output Module is used to examine the three unformatted files (SUMMARY, HISTORY, and MASTER) produced by GSM. In addition, an auxiliary conversion routine is included to convert the formatted climate data to binary records for use by the Far Field State Model (FFSM) program.

28155 (ESTSC–000589C017600) **SALT4: Bedded Salt Radioactive Waste Storage.** Golis, M.J. (Batelle Columbus Division, OH (United States)). Battelle, Columbus, OH (United States). 1 Apr 1983. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-83CH10140. (NESC–9849). Source: ESTSC.

Description: CDC CYBER176; NOS 1.4 (CDC CYBER176); NOS2.5.1FORTRAN IV; 1 Mag Tape.

SALT4 is a two-dimensional, analytical displacement discontinuity code designed to evaluate temperatures, deformation, and stresses associated with underground disposal of radioactive waste in bedded salt. SALT4 takes into account viscoelastic behavior in the pillars adjacent to excavations, transversely isotropic elastic moduli such as those exhibited by bedded or stratified rock, and excavation sequence. SALT4 can be used for parameter sensitivity analyses of two-dimensional, repository-scale, thermal and thermomechanical response in bedded salt during the excavation, operational, and post-closure phases. It is especially useful in evaluating alternative patterns and sequences of excavation or waste canister placement. Although SALT4 was designed for analysis of bedded salt, it is also applicable to crystalline rock if the creep calculation is suppressed. The main disadvantage of SALT4 is that some of the assumptions made, i.e. temperature independent material properties, render it unsuitable for canister-scale analysis or analysis of lateral deformation of the pillars. The SALT4 model can serve as a valuable auxiliary to the more sophisticated SCEPTER finite-element and finite-difference thermal and thermomechanical codes by helping to resolve issues which arise from the finite calculational domain inherent in the latter approaches. The finite-element and finite-difference codes may require a very large number of nodes to circumvent effects of the finite domain inherent in their application. Because of the nature of the influence functions used in the SALT4 formulation, it models a semi-infinite domain and is therefore not subject to this limitation.

28156 (ESTSC–000590C017000) **ICOP: Financial Model Industrial Cogeneration.** Green, L.M. (TRW, McLean, VA (United States)); Burnworth, H.F. TRW Energy Development Group, McLean, VA (United States). 1 Mar 1982. Sponsored by USDOE, Washington, DC (United States). (NESC–971). Source: ESTSC.

Description: CDC CYBER170; MACE; the TRW-modified KRONOS OpFORTRAN IV; 1 Mag Tape. ICOP is adaptable to other computer systems with minor modifications.

The ICOP program performs financial analysis computations in a generic fashion, with special emphasis on the analysis of industrial cogeneration applications. Both undiscounted and discounted cash flows are generated. Measures of financial feasibility include energy savings, internal rate of return, and net present value.

28157 (ESTSC–000592C760000) **WHAM6: Liquid-Filled Piping System Analysis.** Edwards, H. (Argonne National Lab., IL (United States)). Argonne National Lab., IL (United States). 1 Jul 1977. Sponsored by USDOE, Washington, DC (United States). (NESC–278). Source: ESTSC.

Description: CDC7600; SCOPE 2.1.3; FORTRAN IV; 1 Mag Tape.

WHAM6 is used to calculate pressure and velocity transients in liquid-filled piping networks. It can be applied to multiloop complex piping networks consisting of dead ends, elbows, orifices, multiple-branch tees, changes of flow passage cross section, check valves, pumps, pressurizers or tanks, and exit valves or breaks. Hydraulic losses are considered. Transients can be initiated either by closure or opening of one or more exit valves (equivalent to system ruptures) or by a prescribed gas pressure history in a pressurizer tank.

28158 (ESTSC/NRC–000119IBMPC00) **TRAC-PF1: Best-Estimate Analysis PWR LOCA.** Borges, R. (Comissao Nacional de Energia Nuclear (CNEN), Rio de Janeiro, RJ (Brazil)). Comissao Nacional de Energia Nuclear (CNEN), Rio de Janeiro, RJ (Brazil). 1 Feb 1984. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research. (NESC–836). Source: ESTSC.

Description: IBM PC; DOS 3.2 or later; SVS FORTRAN 77; 4 5.25 Diskettes. COMPASS replacement routines for the TRAC-PF1 linear equation solver are included in the CDC package for more efficient operation. For plotting, TRAP, the CDC version graphics program, makes use of the Integrated Software Systems Corporation's (ISSCO) proprietary software product DISSPLA. The conversion from the CDC to IBM environment was done at Gesellschaft fuer Reaktorsicherheit, West Germany, using an Amdahl 470 V/6 II with IBM MVS operating system and the FORTRAN H Extended Enhanced compiler. THIS PACKAGE IS WRITTEN TO USE A DEFINICON 780+ OR 785 MATH COPROCESSOR BOARD. NO SOURCE CODE IS AVAILABLE FOR THIS PACKAGE. THIS PACKAGE COULD NOT BE TESTED BY THE ESTSC.

TRAC-PF1 performs best-estimate analyses of loss of coolant accidents and other transients in pressurized light water reactors. The program can also be used to model a wide range of thermal hydraulic experiments in reduced-scale facilities. Models employed include reflood, multi-dimensional two-phase flow, nonequilibrium thermodynamics, generalized heat transfer, and reactor kinetics. Automatic steady-state and dump/restart capabilities are provided. The changes reported in TRACNEWS issues through Number 7 are incorporated in this release.

28159 (ESTSC/NRC–000579IBMPC00) **REMIT3.0: Radiation Exposure Monitoring and Information Transmittal System.** Dixson, P. (Science Applications International Corp., Oak Ridge, TN (United States)); Clark, T.; Cale, R. Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research. 1 Apr 1993. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research. Source: ESTSC.

Description: IBM PC; DOS; dBASE III; 2 3.5 Diskettes. For 286 computers, the system must have at least 2 megabyte LIM 4.0 compatible expanded memory. For 386 (or higher) computers, the system requires at least 2 megabytes extended memory available and no expanded memory. If expanded memory is present, REMIT will attempt to make use of it instead of the extended memory. Since REMIT uses extended memory much more efficiently than expanded memory on a 386 machine, all references to expanded memory in your CONFIG.SYS file should be removed in order for REMIT to make use of your extended memory. See your DOS manual for information about modifying your CONFIG.SYS file and memory management. The memory management has been designed to meet the minimum system requirements while making use of more advanced features...

The Radiation Exposure Monitoring and Information Transmittal (REMIT) system is designed to assist U.S. Nuclear Regulatory Commission (NRC) licensees in meeting the reporting requirements of the Revised 10 CFR Part 20 and in agreement with the guidance contained in Regulatory Guide 8.7, Rev.1, Instructions for Recording and Reporting Occupational Exposure Data. REMIT is a personal computer (PC)-based menu driven system that facilitates the manipulation of data base files to record and report radiation exposure information. REMIT is designed to be user-friendly and contains the full text of Regulatory Guide 8.7, Rev.1, on-line as well as context-sensitive help throughout the program. The user can enter data directly from NRC Form 5s or Form 4s. REMIT allows the user to view the individual's exposure in relation to regulatory or administrative limits and will alert the user to exposures in excess of these limits. The system also provides for the calculation and summation of dose from intakes and the determination of the dose to the maximally exposed extremity for the monitoring year. REMIT can produce NRC Form 5s and 4s in paper and electronic format and can import/export data from ASCII and data base files.

28160 (ESTSC/NRC/R–000364IBMPC01) **SARA4.15: System Analysis and Risk Assessment System.** Russell, K. (EG and G Idaho Inc., Idaho Falls, ID (United States)). EG and G Idaho, Inc., Idaho Falls, ID (United States). 1 Nov 1992. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research. Source: ESTSC.

Description: IBM PC; IBM Microsoft DOS Version 3.3; MODULA-2; 2 5.25 Diskettes. This software uses the Media Cybernetics HALO graphical support routines. The run time files are included with the software and can be distributed with this software as a license has been acquired. Since no source was provided, only the executable was tested. Also, since no sample problems were provided, testing was very limited.

SARA4.15 is a program that allows the user to review the results of a Probabilistic Risk Assessment (PRA) and to perform limited sensitivity analysis on these results. This tool is intended to be used by a less technical oriented user and does not require the level of understanding of PRA concepts required by a full PRA analysis tool. With this program a user can review the information generated by a PRA analyst and compare the results to those generated by making limited modifications to the data in the PRA. Also included in this program is the ability to graphical display the information stored in the database. This information includes event trees, fault trees, P&IDs and uncertainty distributions.

28161 (ESTSC/NRC/R–000572IBMPC00) **EDSFI: Electrical Distribution System Functional Inspection Data Base.** Bittle, D. (Applied Management Systems, Washington, DC (United States)). Nuclear Regulatory Commission, Washington, DC (United States). Div. of Reactor Inspection and Safeguards. 1 Jan 1993. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Reactor Regulation. Source: ESTSC.

Description: IBM PC; DOS 5.0; FORTRAN; 2 3.5 Diskettes. The EDSFI findings include observations, unresolved issues, or possible deficiencies in the design and implementation of electrical distribution systems in nuclear plants. The findings in the EDSFI database are assigned primary, secondary, and tertiary fields. Each of the five primary fields has a wide scope and includes a summary of EDS problems in that area within the industry. DUE TO THE LACK OF SOURCE CODE AND SAMPLE PROBLEMS, ESTSC RELEASES THIS PACKAGE AS-IS.

This database contains inspection findings from the Nuclear Regulatory Commission's Electrical Distribution System Functional Inspections (EDSFIs). The program enables the user to search and sort findings, ascertain trends, and obtain printed reports of the findings. The findings include observations, unresolved issues, or possible deficiencies in the design and implementation of electrical distribution systems in nuclear plants. This database will assist those preparing for electrical inspections, searching for deficiencies in a plant, and determining the corrective actions previously taken for similar deficiencies. This database will be updated as new EDSFIs are completed.

28162 (IC–93/73) **A strongly nonlinear reaction diffusion model for a deterministic diffusive epidemic.** Kirane, M. (International Centre for Theoretical Physics, Trieste (Italy)); Kouachi, S. International Centre for Theoretical Physics, Trieste (Italy). Apr 1993. [8p.] Order Number DE93628569. Source: OSTI; NTIS (US Sales Only); INIS.

In the present paper the mathematical validity of a model on the spread of an infectious disease is proved. This model was proposed by Bailey. The mathematical validity is proved by means of a positivity, uniqueness and existence theorem. Moreover the large time behaviour of the global solutions is analyzed. In spite of the apparent simplicity of the problem, the solution requires a delicate set of techniques. It seems very difficult to extend these techniques to a model in more than one dimension without imposing conditions on the data. (author). 9 refs.

28163 (IC–93/92) **Stability analysis for an age-dependent vaccination model.** El-Doma, M. International Centre for Theoretical Physics, Trieste (Italy). May 1993. [12p.] Order Number DE93628570. Source: OSTI; NTIS (US Sales Only); INIS.

The stability of an SIR epidemic model with vaccination is investigated. We determine the steady states and examine their stability. Furthermore, a critical vaccination coverage that will eventually eradicate the disease is determined. (author). 9 refs.

28164 (INIS-mf–12758, pp. 89-92) **Post-processing of the TRAC code's results.** Baron, J.H. (Comision Nacional de Energia Atomica, San Carlos de Bariloche (Argentina). Centro Atomico Bariloche); Neuman, D. Asociacion Argentina de Tecnologia Nuclear, Buenos Aires (Argentina). 1987. [735p.] (In Spanish). (CONF-8711355–: 15. scientific meeting and 4th Latin American meeting and 1st sessions on nuclear power plants, San Carlos de Bariloche (Argentina), 2-6 Nov 1987). In *Proceedings of the fifteenth scientific meeting; fourth Latin American meeting; first sessions on nuclear power plants.* Order Number DE91003052. Source: OSTI; NTIS (US Sales Only); INIS.

The TRAC code serves for the analysis of accidents in nuclear installations from the thermohydraulic point of view. A program has been developed with the aim of processing the information rapidly generated by the code, with screening graph capacity, both in high and low resolution, or either in paper through printer or plotter. Although the programs are intended to be used after the TRAC runs, they may be also used even when the program is running so as to observe the calculation process. The advantages of employing this type of tool, its actual capacity and its possibilities of expansion according to the user's needs are herein described. (Author).

28165 (JINR-R–11-92-100) **ASYS: a computer algebra package for analysis of nonlinear algebraic equations systems.** Gerdt, V.P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation); Khutornoj, N.V.; Zharkov, A.Yu. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Computing Techniques and Automation. 1992. [19p.] (In Russian). Order Number DE93629819. Source: OSTI; NTIS (US Sales Only); INIS.

Submitted to Programmirovanie.

A program package ASYS for analysis of nonlinear algebraic equations based on the Groebner basis technique is described. The package is written in REDUCE computer algebra language. It has special facilities to treat polynomial ideals of positive dimension, corresponding to algebraic systems with infinitely many solutions. Such systems can be transformed to an equivalent set of subsystems with reduced number of variables in completely automatic way. It often allows to construct the explicit form of a solution set in many problems of practical importance. Some examples and results of comparison with the standard Reduce package GROEBNER and special-purpose systems FELIX and A1PI are given. 21 refs.; 2 tabs.

28166 (K/DSRD/FTR–150) **Standards on computers in document processing and related communication: Foreign trip report, November 13–23, 1992.** Snyder, C.E. Oak Ridge K-25 Site, TN (United States). 4 Dec 1992. 41p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OT21400. Order Number DE93009135. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The traveler participates in the International Organization for Standardization (ISO) work on computers in Document Processing and Related Communication. The November, 1992, meeting of Working Group 9 (WG9) considered international comments on draft standards for keyboards, cursor control, icons, and names of objects and actions. A document placing the Q on the 7 and the Z on the 9 of the telephone-style keypad was recommended for Draft International Standard processing. A working paper summarizing options for conformance to the icon standard was produced. User requirements were produced for icons and objects and action standardization. In addition, a first working draft for a voice messaging standard was produced.

28167 (LA-UR–93-1181) **Addressing the insider threat.** Hochberg, J.G.; Jackson, K.A.; McClary, J.F.; Simmonds, D.D. Los Alamos National Lab., NM (United States). [1993]. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9305151–3: 15. computer security group training conference: mission possible - connected and protected, Albuquerque, NM (United States), 3-6 May 1993). Order Number DE93012626. Source: OSTI; NTIS; GPO Dep.

Computers have come to play a major role in the processing of information vital to our national security. As we grow more dependent on computers, we also become more vulnerable to their misuse. Misuse may be accidental, or may occur deliberately for purposes of personal gain, espionage, terrorism, or revenge. While it is difficult to obtain exact statistics on computer misuse, clearly it is growing. It is also clear that insiders – authorized system users – are responsible for most of this increase. Unfortunately, their insider status gives them a greater potential for harm This paper takes an asset-based approach to the insider threat. We begin by characterizing the insider and the threat posed by variously motivated insiders. Next, we characterize the asset of concern: computerized information of strategic or economic value. We discuss four general ways in which computerized information is vulnerable to adversary action by the insider: disclosure, violation of integrity, denial of service, and unauthorized use of resources. We then look at three general remedies for these vulnerabilities. The first is formality of operations, such as training, personnel screening, and configuration management. The second is the institution of automated safeguards, such as single-use passwords, encryption, and biometric devices. The third is the development of automated systems that collect and analyze system and user data to look for signs of misuse.

28168 (LA-UR–93-1287) **A network evaluation and analysis tool.** Stoltz, L.A.; Whiteson, R.; Fasel, P.K.; Temple, R.; Dreicer, J.S. Los Alamos National Lab., NM (United States). [1993]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930773–2: 9. international conference on systems engineering (ICSE '93), Las Vegas, NV (United States), 14-16 Jul 1993). Order Number DE93012647. Source: OSTI; NTIS; GPO Dep.

The rapid emergence of large heterogeneous networks, distributed systems, and massively parallel computers has resulted in economies of scale, enhanced productivity, efficient communication, resource sharing, and increased reliability, which are computationally beneficial. In addition to these benefits, networking presents technical challenges and problems with respect to maintaining and ensuring the security, design, compatibility, integrity, functionality, and management of these systems. In this paper we describe a computer security tool, Network Evaluation and Analysis Tool (NEAT), that we have developed to address these concerns.

28169 (LA-UR–93-1565) **Identification of continuous-time dynamical systems: Neural network based algorithms and parallel implementation.** Farber, R.M. (Los Alamos National Lab., NM (United States)); Lapedes, A.S.; Rico-Martinez, R.; Kevrekidis, I.G. Los Alamos National Lab., NM (United States). [1993]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930331–11: 6. Society for Industrial and Applied Mathematics (SIAM) conference on parallel processing for scientific computing, Norfolk, VA (United States), 21-24 Mar 1993). Order Number DE93014427. Source: OSTI; NTIS; GPO Dep.

Time-delay mappings constructed using neural networks have proven successful performing nonlinear system identification; however, because of their discrete nature, their use in bifurcation analysis of continuous-tune systems is limited. This shortcoming can be avoided by embedding the neural networks in a training algorithm that mimics a numerical integrator. Both explicit and implicit integrators can be used. The former case is based on repeated evaluations of the network in a feedforward implementation; the latter relies on a recurrent network implementation. Here the algorithms and their implementation on parallel machines (SIMD and MIMD architectures) are discussed.

28170 (LA-UR–93-1569) **Thermodynamics of computation and information distance.** Bennett, C.H.; Gacs, P.; Li, M.; Vitanyi, P.M.B.; Zurek, W.H. Los Alamos National Lab., NM (United States). 12 Mar 1993. 21p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9306155–1: Symposium on theory of computation (STOC), San Diego, CA (United States), 7-11 Jun 1993). Order Number DE93012730. Source: OSTI; NTIS; GPO Dep.

Applying the tools of algorithmic information theory, we compare several candidates for an asymptotically machine-independent. absolute measure of the informational or "cognitive" distance between discrete objects x and y. The maximum of the conditional Kolmogorov complexities max{K(y|z) K(m|y)}, is shown to be optimal, in the sense of being minimal within an additive constant among semicomputable, symmetric, positive semidefinite functions of z and y satisfying a reasonable normalization condition and obeying the triangle intequality. The optimal metric, in turn, differs by at most an additive logarithmic term from the size of the smallest program for a universal reversible computer to transform x into y. This program functions in a 'catalytic" capacity, being retained in the computer before, during, and after the computation. Similarly, the sum of the conditional complexities. K(y|x) + K(x|y), is shown to be equal within a logarithmic term to the minimal amount Of information flowing out and in during a reversible computation in which the program is not retained. Finally. using the physical theory of reversible computation, it is shown that the simple difference K(x) - K(y) is an appropriate (ie universal, antisymmetric, and transitive) measure of the amount of thermodynamic work required to transform string x into string y by the most efficient process.

28171 (LA-UR–93-1981) **Efficiency effects of variation in controlled experimental variables.** Wendelbeger, J.R. Los Alamos National Lab., NM (United States). [1993]. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9308107–1: American Statistical Association (ASA) conference, San Francisco, CA (United States), 11 Aug 1993). Order Number DE93014345. Source: OSTI; NTIS; GPO Dep.

When a designed experiment is conducted, the exact levels of controlled experimental variables specified by the design may not be attainable. Two different types of situations can occur in which the actual settings of the design variables deviate from the target design settings. In one case, the actual settings obtained are unknown. In the other case, the actual settings are known; however desirable design properties such as orthogonality may have been

lost. This paper examines the impact of known and unknown errors in experimental variables for designed experiments in which the response is assumed to be approximately linear in the region of interest. For comparison, the well known situation where the target values of the experimental variables can actually be obtained will also be considered.

28172 (LA-UR–93-1983) **Adaptive Transfer Function Networks.** Goulding, J.R. (Los Alamos National Lab., NM (United States)). Los Alamos National Lab., NM (United States). [1993]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930741–3: World congress on neural networks, Portland, OR (United States), 11-15 Jul 1993). Order Number DE93014344. Source: OSTI; NTIS; GPO Dep.

Real-time pattern classification and time-series forecasting applications continue to drive artificial neural network (ANN) technology. As ANNs increase in complexity, the throughput of digital computer simulations decreases. A novel ANN, the Adaptive Transfer Function Network (ATF-Net), directly addresses the issue of throughput. ATF-Nets are global mapping equations generated by the superposition of ensembles of neurodes having arbitrary continuous functions receiving encoded input data. ATF-Nets may be implemented on parallel digital computers. An example is presented which illustrates a four-fold increase in computational throughput.

28173 (ORNL/TM–12269) **Rare attributes in finite universe: Hypotheses testing specification and exact randomized upper confidence bounds.** Wright, T. Oak Ridge National Lab., TN (United States). Mar 1993. 33p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93012783. Source: OSTI; NTIS; GPO Dep.

When attributes are rare and few or none are observed in the selected sample from a finite universe, sampling statisticians are increasingly being challenged to use whatever methods are available to declare with high probability or confidence that the universe is near or completely attribute-free. This is especially true when the attribute is undesirable. Approximations such as those based on normal theory are frequently inadequate with rare attributes. For simple random sampling without replacement, an appropriate probability distribution for statistical inference is the hypergeometric distribution. But even with the hypergeometric distribution, the investigator is limited from making claims of attribute-free with high confidence unless the sample size is quite large using nonrandomized techniques. In the hypergeometric setting with rare attributes, exact randomized tests of hypothesis a,re investigated to determine the effect on power of how one specifies the null hypothesis. In particular, specifying the null hypothesis as zero attributes does not always yield maximum possible power. We also consider the hypothesis specification question under complex sampling designs including stratified random sampling and two-stage cluster sampling (one case involves random selection at first stage and another case involves probability proportional to size without replacement selection at first stage). Also under simple random sampling, this article defines and presents a simple algorithm for the construction of exact "randomized" upper confidence bounds which permit one to possibly report tighter bounds than those exact bounds obtained using "nonrandomized" methods.

28174 (ORNL/TM–12356) **Broadcasting on linear arrays and meshes.** Seidel, S.R. (Michigan Technological Univ., Houghton, MI (United States). Dept. of Computer Science). Oak Ridge National Lab., TN (United States). Mar 1993. 42p. Sponsored by USDOE, Washington, DC (United States); National Aeronautics and Space Administration, Washington, DC (United States). DOE Contract AC05-84OR21400. Grant NAG2-757. Order Number DE93013805. Source: OSTI; NTIS; GPO Dep.

The well known spanning binomial tree broadcast algorithm is generalized to obtain several new broadcast algorithms for linear arrays and meshes. These generalizations take advantage of bidirectional communication, the connectivity of two-dimensional meshes, and the difference between node-to-network and network-to-network bandwidth. It is shown how these algorithms can be further generalized so that any node can be the source of the broadcast message. A partitioning scheme is given that allows these algorithms to be used on linear arrays and meshes of any size. One of these algorithms, the bidirectional spanning tree broadcast, always has lower cost than the recursive halving broadcast for linear arrays. All of these algorithms offer significant performance improvements over the basic spanning tree broadcast. These algorithms do not rely on a knowledge of machine dependent constants for network bandwidth and latency, so their performance is not as sensitive to changes in machine characteristics as that of hybrid and pipelined algorithms. Performance measurements are given for some of these broadcast algorithms on the Intel Delta mesh.

28175 (ORNL/TM–12375, pp. 1-11) **Implications in vivid logic.** Akama, Seiki (Teikyo Univ. of Technology, Chiba (JP)); Ohnishi, Hiroto. Oak Ridge National Lab., TN (United States). May 1993. (CONF-9306151–: 7. international symposium on methodologies for intelligent systems, Trondheim (Norway), 15-18 Jun 1993). In *Proceedings of the Seventh International Symposium on Methodologies for Intelligent Systems (Poster Session).* 174p. Order Number DE93013470. Source: OSTI; NTIS.

The authors discuss implications in vivid logic to enhance the expressive power concerning conditional knowledge. This can be accomplished as an extension of Wagner's partial logical framework. It is shown that the resulting system is equivalent to Nelson's constructive logic. The authors also argue inconsistency handling in the proposed framework. 18 refs.

28176 (ORNL/TM–12375, pp. 27-43) **A natural language generation system for a heterogeneous distributed database system.** Desai, B.C. (Concordia Univ., Montreal (CA)). Oak Ridge National Lab., TN (United States). May 1993. (CONF-9306151–: 7. international symposium on methodologies for intelligent systems, Trondheim (Norway), 15-18 Jun 1993). In *Proceedings of the Seventh International Symposium on Methodologies for Intelligent Systems (Poster Session).* 174p. Order Number DE93013470. Source: OSTI; NTIS.

In this paper the authors describe the design issues of a database independent natural language generation system (NLG system) targeted for non-technical users. The NLG system generates output in the form of a coherent, consistent and stylish text. A prototype NLG system which addresses these issues has been built for integration into a multilevel interface for a Heterogeneous Distributed Database Management System. 30 refs., 9 figs.

28177 (ORNL/TM–12375, pp. 55-69) **Strategy acquisition by an artificial neural network: Experiments in learning to play a stochastic game.** Mazur, N.M. (Union College, Schenectady, NY (US)). Oak Ridge National Lab., TN (United States). May 1993. (CONF-9306151–: 7. international symposium on methodologies for intelligent systems, Trondheim (Norway), 15-18 Jun 1993). In *Proceedings of the Seventh International Symposium on Methodologies for Intelligent Systems (Poster Session).* 174p. Order Number DE93013470. Source: OSTI; NTIS.

Artificial neural networks have been successfully used to perform a variety of tasks, mostly in the areas of pattern recognition and classification. This paper explores their use in learning and executing strategies. A series of experiments are performed in which a network using the backpropagation algorithm learns strategies for playing the game of casino blackjack. The experiments range from the supervised learning of a blackjack strategy using the normal backpropagation regime, to supervised learning using situations generated from the naturally occurring probabilities of the game, and, finally, to an unsupervised experiment where the network learns a strategy based on its performance and past experience in playing. The latter experiments introduce probabilistic and contradictory feedback to the network due to the stochastic nature of the game. The experiments show that artificial neural networks can be used to represent and learn strategies for a stochastic game and that their performance can be favorably compared to that of human players. 14 refs., 11 figs., 1 tab.

28178 (ORNL/TM–12375, pp. 70-79) **Viewpoints and selective inheritance in object-oriented modeling.** Oivo, M. (Technical Research Centre of Finland, Oulu (FI)). Oak Ridge National Lab., TN (United States). May 1993. (CONF-9306151–: 7. international symposium on methodologies for intelligent systems, Trondheim

(Norway), 15-18 Jun 1993). In *Proceedings of the Seventh International Symposium on Methodologies for Intelligent Systems (Poster Session)*. 174p. Order Number DE93013470. Source: OSTI; NTIS.

Object-oriented modeling is a powerful and natural knowledge representation mechanism for many real-life applications. However, there are situations when the traditional object-oriented modeling and inheritance lattices are not sufficient. The authors introduce a dynamic viewpoint mechanism with selective inheritance for building models in the context of software engineering and for viewing the models from multiple perspectives. Furthermore, a set of inter-object relationships is described which can be used to enhance the traditional object-oriented and frame-based modeling mechanisms. These methods and techniques have been implemented in a prototype system and they have been used to model various software engineering activities and elements. 21 refs., 3 figs.

28179 (ORNL/TM–12375, pp. 95-109) **Utilization of the case-based reasoning method to resolve dynamic problems.** Rougegrez, S. (Universite Pierre & Marie Curie, Paris (FR)). Oak Ridge National Lab., TN (United States). May 1993. (CONF-9306151–: 7. international symposium on methodologies for intelligent systems, Trondheim (Norway), 15-18 Jun 1993). In *Proceedings of the Seventh International Symposium on Methodologies for Intelligent Systems (Poster Session)*. 174p. Order Number DE93013470. Source: OSTI; NTIS.

Case-based reasoning allows resolution of problems by comparison with already resolved ones. This technique is being utilized for domains in which little knowledge is correctly formalized. A minimum of knowledge has to be available to represent cases stored in memory, called a case base. This knowledge does not always exist, as is shown in this paper. A definition of viewpoints is proposed in which this system of case-based reasoning permits prediction of evolution of problems from a given time. 13 refs., 4 figs.

28180 (ORNL/TM–12375, pp. 80-94) **Multivariate discretization of continuous attributes for machine learning.** Rauber, T.W. (Universidade Nova de Lisboa, Monte deCaparica (PT)); Steiger-Garcao, A.S.; Coltuc, D. Oak Ridge National Lab., TN (United States). May 1993. (CONF-9306151–: 7. international symposium on methodologies for intelligent systems, Trondheim (Norway), 15-18 Jun 1993). In *Proceedings of the Seventh International Symposium on Methodologies for Intelligent Systems (Poster Session)*. 174p. Order Number DE93013470. Source: OSTI; NTIS.

Symbolic Machine teaming algorithms like decision tree or rule induction programs must discretize continuous attributes. This symbolization of continuous values is usually done in an univariate way. That means that the attributes are transformed from continuous to discrete space independently from each other. For each attribute the infinite range of its possible values is discretized to a finite number of values which from there onwards are considered as symbolic. In this paper the authors propose multivariate discretization of continuous attributes as a preprocessing step of symbolic induction. The generated symbolic values represent not only a single continuous attribute, but a multidimensional discretization of many continuous attributes. The novel approach is to merge several continuous attributes in order to discretize them and to use this multivariate discretization as a preprocessor for the symbolization of continuous attributes in inductive learning. Furthermore the authors propose the Q* algorithm which is capable of learning multivariate prototypes in an Euclidean space. It is a self-organizing supervised learning method which condenses the raw sample data to a representative set of prototypes. The algorithm can be used for the multivariate quantization philosophy that is proposed in this text. Experimental results are presented for a classification task. Instead of the normally univariate quantization, multivariate quantization using Q* is employed. 19 refs., 6 figs., 3 tabs.

28181 (ORNL/TM–12375, pp. 125-139) **Linguistic tools for intelligent systems.** Stillman, B. (Univ. of Colorado, Denver (US)). Oak Ridge National Lab., TN (United States). May 1993. (CONF-9306151–: 7. international symposium on methodologies for intelligent systems, Trondheim (Norway), 15-18 Jun 1993). In *Proceedings of the Seventh International Symposium on Methodologies for Intelligent Systems (Poster Session)*. 174p. Order Number DE93013470. Source: OSTI; NTIS.

The objective of the research considered in this paper is to develop formal linguistic tools for the representation of large-scale hierarchical complex systems, the so-called Linguistic Geometry. The research relies on the formalization of heuristics of high-skilled human experts which have resulted in the development of successful decision support systems. This approach is based on a broad application of the theory of formal languages and grammars as well as theories of formal problem-solving and planning on the basis of the first-order predicate calculus. This paper reports new results in the investigation of geometrical properties of the first-level subsystems (paths of elements) unified as One-Dimensional Linguistic Geometry. 28 refs., 3 figs., 1 tab.

28182 (ORNL/TM–12375, pp. 140-150) **An application of rough sets in knowledge synthesis.** Wong, S.K.M. (Univ. of Regina, Saskatchewan (CA)); Yao, Y.Y.; Wang, L.S. Oak Ridge National Lab., TN (United States). May 1993. (CONF-9306151–: 7. international symposium on methodologies for intelligent systems, Trondheim (Norway), 15-18 Jun 1993). In *Proceedings of the Seventh International Symposium on Methodologies for Intelligent Systems (Poster Session)*. 174p. Order Number DE93013470. Source: OSTI; NTIS.

In this paper, the authors consider the fundamental issues in knowledge verification and synthesis by focusing on a special type of rule-based systems, which consists of a set of deterministic and non-deterministic decision rules. A set of sound and complete inference axioms is suggested. Based on these axioms, an efficient algorithm is developed for computing the closure and testing the consistency of the input rules. 18 refs.

28183 (PNL-SA–21610) **Automation of constrained-value business forms.** Carson, M.L.; Beaumariage, T.G.; Greitzer, F.L. Pacific Northwest Lab., Richland, WA (United States). May 1993. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-9305218–1: 2. international engineering research conference, Los Angeles, CA (United States), 23-26 May 1993). Order Number DE93015677. Source: OSTI; NTIS; GPO Dep.

Expert systems can improve many business tasks. However, the nature of a constrained-value business form can result in a rule base that contains circular reasoning, unsuitable for expert system implementation. A methodology is presented for restructuring such a rule base for compatibility with a backward-chaining expert system.

28184 (SAND–92-2059C) **A general contact detection algorithm for finite element analysis.** Heinstein, M.W.; Attaway, S.W.; Swegle, J.W.; Mello, F.J. Sandia National Labs., Albuquerque, NM (United States). [1992]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-930782–1: 1. international conference in contact mechanics, Southampton (United Kingdom), 13-15 Jul 1993). Order Number DE93012846. Source: OSTI; NTIS; GPO Dep.

A contact detection algorithm has been developed to address difficulties associated with the numerical simulation of contact in nonlinear finite element structural analysis codes. Mechanics problems which have self-contacting surfaces, tearing and eroding surfaces, and multi-body impact are solved using the new algorithm. The proposed algorithm is portable between dynamic and quasi-static codes and can efficiently model contact between a variety of finite element types including shells, bricks, beams and particles. The algorithm is composed of (1) a location strategy that uses a global search to decide which slave nodes are in proximity to a master surface and (2) an accurate detailed contact check that uses the projected motions of both master surface and slave node. The capability of the new algorithm is illustrated with several example problems.

28185 (SAND–92-2765) **An efficient parallel algorithm for matrix-vector multiplication.** Hendrickson, B.; Leland, R.; Plimpton, S. Sandia National Labs., Albuquerque, NM (United States). Mar 1993. 21p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93015125. Source: OSTI; NTIS; GPO Dep.

The multiplication of a vector by a matrix is the kernel computation of many algorithms in scientific computation. A fast parallel

algorithm for this calculation is therefore necessary if one is to make full use of the new generation of parallel supercomputers. This paper presents a high performance, parallel matrix-vector multiplication algorithm that is particularly well suited to hypercube multiprocessors. For an n x n matrix on p processors, the communication cost of this algorithm is $O(n/\sqrt{p} + \log(p))$, independent of the matrix sparsity pattern. The performance of the algorithm is demonstrated by employing it as the kernel in the well-known NAS conjugate gradient benchmark, where a run time of 6.09 seconds was observed. This is the best published performance on this benchmark achieved to date using a massively parallel supercomputer.

28186 (SAND–93-0735) **Locally non-uniform finite-difference time domain with application to stealth, crosstalk, and narrow apertures.** Riley, D.J. Sandia National Labs., Albuquerque, NM (United States). Apr 1993. 104p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93013958. Source: OSTI; NTIS; GPO Dep.

A technique to integrate a dense, locally non-uniform mesh into finite-difference time-domain (FDTD) codes is presented. The method is designed for the full-wave analysis of multi-material layers that are physically thin, but perhaps electrically thick. Such layers are often used for the purpose of suppressing electromagnetic reflections from conducting surfaces. Throughout the non-uniform local mesh, average values for the conductivity and permittivity are used, where as variations in permeability are accommodated by splitting H-field line integrals and enforcing continuity of the normal B field. A unique interpolation scheme provides accuracy and late-time stability for mesh discontinuities as large as 1000 to 1. Application is made to resistive sheets, the absorbing Salisbury screen, crosstalk on printed circuit boards, and apertures that are narrow both in width and depth with regard to a uniform cell. Where appropriate, comparisons are made with the MoM code CARLOS and transmission-line theory. The hybrid mesh formulation has been highly optimized for both vector and parallel-processing on Cray YMP architectures.

28187 (SAND–93-0961) **Refining and defining the Program Dependence Web.** Campbell, P.L. (Sandia National Labs., Albuquerque, NM (United States)); Krishna, K.; Ballance, R.A. Sandia National Labs., Albuquerque, NM (United States). May 1993. 40p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93014852. Source: OSTI; NTIS; GPO Dep.

The Program Dependence Web (PDW) is an intermediate representation for a computer program, which can be interpreted under control-driven, data-driven or demand-driven disciplines. This document completes the definition for the PDW. This includes operational definitions for the nodes and arcs and a description of how PDWs are interpreted. The general structure for conditionals and loops is shown, accompanied by examples. The definition provided here is a refinement of the original one: a new node, the "β node," replaces the μ node, and the η^T node is eliminated.

28188 (SAND–93-1002C) **A perspective on AVS in an engineering sciences environment.** Glass, M.W. Sandia National Labs., Albuquerque, NM (United States). [1993]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9305168–3: Application Visualization System (AVS) '93 users group meeting, Orlando, FL (United States), 24-26 May 1993). Order Number DE93015011. Source: OSTI; NTIS; GPO Dep.

At Sandia National Laboratories, the Engineering Sciences Center has made a commitment to integrate Application Visualization System (AVS) into our computing environment as the primary tool for scientific visualization. AVS will be used on an everyday basis by a broad spectrum of users ranging from the occasional computer user to AVS module developers. Additionally, AVS will be used to visualize structured grid, unstructured grid, gridless, 1D, 2D, 3D, steady-state, transient, computational, and experimental data. The following is one user's perspective on how AVS meets this task. Several examples of how AVS is currently being utilized will be given along with some future directions.

28189 (SAND–93-1353C) **C++ as a language for object-oriented numerics.** Budge, K.G.; Peery, J.S.; Robinson, A.C.; Wong, M.K. Sandia National Labs., Albuquerque, NM (United States). [1993]. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-930791–1: European C++ Users Group meeting, Munich (Germany), 7-9 Jul 1993). Order Number DE93015027. Source: OSTI; NTIS; GPO Dep.

C++ is commonly described as an object-oriented programming language because of its strong support for classes with multiple inheritance and polymorphism. However, for a growing community of numerical programmers, an equally important feature of C++ is its support of operator overloading on abstract data types. The authors choose to call the resulting style of programming object-oriented numerics. They believe that much of object-oriented numerics is orthogonal to conventional object-oriented programming. As a case study, they discuss two strong shock physics codes written in C++ that they're currently developing. These codes use both polymorphic classes (typical of traditional object-oriented programming) and abstract data types with overloaded operators (typical of object-oriented numerics). They believe that C++ translators can generate efficient code for many numerical objects. However, for the important case of smart arrays (which are used to represent matrices and the fields found in partial differential equations) fundamental difficulties remain. The authors discuss the two most important of these, namely, the aliasing ambiguity and the proliferation of temporaries, and present some possible solutions.

28190 (SLAC-PUB–5967) **Overview of the Scalable Coherent Interface, IEEE STD 1596 (SCI).** Gustavson, D.B. (Stanford Linear Accelerator Center, Menlo Park, CA (United States)); James, D.V.; Wiggers, H.A. Stanford Linear Accelerator Center, Menlo Park, CA (United States). Oct 1992. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00515. (CONF-921005–34: Institute of Electrical and Electronic Engineers (IEEE) nuclear science symposium and medical imaging conference, Orlando, FL (United States), 26-31 Oct 1992). Order Number DE93015247. Source: OSTI; NTIS; INIS; GPO Dep.

The Scalable Coherent Interface standard defines a new generation of interconnection that spans the full range from supercomputer memory 'bus' to campus-wide network. SCI provides bus-like services and a shared-memory software model while using an underlying, packet protocol on many independent communication links. Initially these links are 1 GByte/s (wires) and 1 GBit/s (fiber), but the protocol scales well to future faster or lower-cost technologies. The interconnect may use switches, meshes, and rings. The SCI distributed-shared-memory model is simple and versatile, enabling for the first time a smooth integration of highly parallel multiprocessors, workstations, personal computers, I/O, networking and data acquisition.

28191 (SOL–93-3) **A sequential quadratic programming algorithm using an incomplete solution of the subproblem.** Murray, W. (Stanford Univ., CA (United States). Systems Optimization Lab.); Prieto, F.J. Stanford Univ., CA (United States). Systems Optimization Lab. May 1993. 54p. Sponsored by USDOE, Washington, DC (United States); National Science Foundation, Washington, DC (United States). DOE Contract FG03-92ER25117. Grant DDM-9204208;Grant N00014-90-J-1242;Grant NATO500525. Order Number DE93017439. Source: OSTI; NTIS; GPO Dep.

We analyze sequential quadratic programming (SQP) methods to solve nonlinear constrained optimization problems that are more flexible in their definition than standard SQP methods. The type of flexibility introduced is motivated by the necessity to deviate from the standard approach when solving large problems. Specifically we no longer require a minimizer of the QP subproblem to be determined or particular Lagrange multiplier estimates to be used. Our main focus is on an SQP algorithm that uses a particular augmented Lagrangian merit function. New results are derived for this algorithm under weaker conditions than previously assumed; in particular, it is not assumed that the iterates lie on a compact set.

28192 (SSI–92-12) **Lena$_W$in 1.0, user's guide.** Baeverstam, U. Swedish Radiation Protection Inst., Stockholm (Sweden). Aug 1992. [29p.] Order Number DE93631734. Source: OSTI; NTIS; INIS.

Lena$_W$in is a program for dispersion and dose calculations, mainly connected to accidents in nuclear facilities. Besides that, it may, however, also be used for other kinds of releases. It is designed to be used both for training purpose, and in real situations. Great care has therefore been taken to ensure a simple and quick handling of the program, also in difficult situations. The program is a true Windows application, and works with version 3.0 and higher of Microsoft Windows. It was developed at the Swedish Radiation Protection Institute (SSI) during 1991-1992, and is used by the institute in its regular work. Lena$_W$in is part in a larger system to handle accidental situations. An important part of this system is a database and a database handler to manage all kinds of measured data after a release. Lena$_W$in has functions to display data taken from this database on maps.

28193 (UCRL-JC–109851) **Standards and practices for reliable safety-related software systems.** Sparkman, D. Lawrence Livermore National Lab., CA (United States). Mar 1992. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9210357–1: 3. international symposium on software reliability engineering, Triangle Park, NC (United States), 7-9 Oct 1992). Order Number DE93012591. Source: OSTI; NTIS; GPO Dep.

Safety and reliability are of increasing concern as mechanical systems are replaced or upgraded with computer-based software technology as we move into the 21st century. As these systems are installed in ever increasing numbers. Their impact on the safety of our environment, finances, and physical well-being grows. The operators, patients, owners, and customers of these systems want assurances that these systems are safe. The developers of these systems attempt to follow standards and industry recognized practices in the hope of providing this assurance. This paper is the result of an evaluation of domestic and international, industry and government accepted practices and standards relating to software safety and reliability. Standards were evaluated for similarities and variance. There are three areas of interest when discussing the development of safety-related software systems. These are the quality enhancing development processes, safety analysis techniques, and measurement techniques for assessing reliability or safety.

28194 (UCRL-JC–110110) **Visualization of high resolution, three-dimensional, nonlinear finite element analyses.** Christon, M.A.; Spelce, T.E. Lawrence Livermore National Lab., CA (United States). 24 Mar 1992. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-921079–5: Visualization 1992, Boston, MA (United States), 19-23 Oct 1992). Order Number DE93015979. Source: OSTI; NTIS; GPO Dep.

A two-pass surface extraction algorithm for adaptive finite element meshes is presented in the context of a visualization study for a particle impact and a turbine containment problem. The direct use of finite element data structures for the computation of external surfaces, surface normals, and derived physical quantities is discussed. An overview of the in-betweening algorithm which compensates for rigid body dynamics is presented with a brief discussion of a "direct-to-videodisk" animation strategy.

28195 (UCRL-JC–111558-Rev.1) **Storage systems for national information assets: Revision 1.** Coyne, R.A. (IBM Federal Systems Div., Houston, TX (United States)); Hulen, H.; Watson, R. Lawrence Livermore National Lab., CA (United States). 17 Feb 1993. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-921125–7: ACM/IEEE supercomputing conference, Minneapolis, MN (United States), 14-21 Nov 1992). Order Number DE93015101. Source: OSTI; NTIS; GPO Dep.

An industry-led collaborative project, called the National Storage Laboratory, has been organized to investigate technology for storage system that will be the future repositories for our national information assets. Lawrence Livermore National Laboratory through its National Energy Research Supercomputer Center (NERSC) is the operational site and the provider of applications. It is anticipated that the integrated testbed system will represent a significant advance in the technology for distributed storage system capable of handling gigabyte class files at gigabit-per-second data rates.

28196 (UCRL-JC–111816-Rev.1) **The National Storage Laboratory: A collaborative research project: Revision 1.** Coyne, R.A. (International Business Machines Corp., Houston, TX (United States)); Hulen, H.; Watson, R. Lawrence Livermore National Lab., CA (United States). 17 Feb 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-920966–25-Rev.1: 10. conference on computing in high energy physics, Annecy (France), 21-25 Sep 1992). Order Number DE93015099. Source: OSTI; NTIS; GPO Dep.

Large scientific, engineering and commercial applications are straining storage and networking facilities, a condition compounded by new supercomputers, massively parallel processors, and workstations. An application driven, industry-led, collaborative, storage testbed project centered at Lawrence Livermore National Laboratory (LLNL), called the National Storage Laboratory, has been organized to investigate, demonstrate, and commercialize technology to remove performance bottlenecks and to provide new needed storage system functionality. The experience of the project will also contribute to the work of the IEEE Storage System Standards Working Group.

28197 (UCRL-JC–112195) **Programming the multimodal interface.** Glinert, E.P. (Rensselaer Polytechnic Inst., Troy, NY (United States). Dept. of Computer Science); Blattner, M.M. Lawrence Livermore National Lab., CA (United States). 10 Sep 1992. 8p. Sponsored by USDOE, Washington, DC (United States); National Science Foundation, Washington, DC (United States). DOE Contract W-7405-ENG-48. CDA-8805910. (CONF-9304147–1: INTERCHI '93: interact and computation human interaction, Amsterdam (Netherlands), 24-29 Apr 1993). Order Number DE93013084. Source: OSTI; NTIS; GPO Dep.

Fundamental problems will confront those who wish to take full advantage of the power of tomorrow's multimodal environments. We argue that our recently introduced concept of meta-widget, when embedded within a high level, networked user interface server, can support the effective implementation of complex multimedia applications. We develop algorithms which enable a multimodal system to select the "best" combination of representations for the various "information packets" in a display at any moment. If no acceptable - combination of available representations can be found, strategies are provided for creating a new and useful, if not beautiful, representation to resolve the impasse. A running example is provided to motivate and clarify the discussion.

28198 (UCRL-JC–112572) **A Task Adaptive parallel graphics renderer.** Whitman, S. Lawrence Livermore National Lab., CA (United States). 21 Dec 1992. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-930881–3: Siggraph '93 conference, Anaheim, CA (United States), 2-6 Aug 1993). Order Number DE93017123. Source: OSTI; NTIS; GPO Dep.

This paper presents a graphics renderer which incorporates new partitioning methodologies of memory and work for efficient execution on a parallel computer. The Task Adaptive domain decomposition scheme is an image space method involving dynamic partitioning of rectangular pixel area tasks. The author shows that this method requires little overhead, allows coherence within a parallel context, handles worst case scenarios effectively, and executes efficiently with little processor synchronization necessary. Previous research in the area of memory and work decompositions for graphics rendering has been primarily limited to simulation studies and little practical experience. The algorithm presented here has been implemented on a scalable distributed memory multiprocessor and tested on a variety of input scenes. The author presents a theoretical and practical analysis in order to contrast its predicted and actual success. The implementation analysis indicates that load imbalance is the major cause of performance degradation at the higher processor counts. Even so, on a variety of test scenes, an average rendering speedup of 79 was achieved utilizing 96 processors on the BBN TC2000 multiprocessor with a processor efficiency range of 66% to 94%.

28199 (UCRL-JC–113106) **Control of movement in an arbitrary polygonal terrain.** Cunningham, C.T. Lawrence Livermore National Lab., CA (United States). 4 Feb 1993. 10p. Sponsored by

USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9303101–2: 3. conference on computer generated forces and BR, Orlando, FL (United States), 17-19 Mar 1993). Order Number DE93016539. Source: OSTI; NTIS; GPO Dep.

Efficient algorithms are presented for coordinated movement of semi-automated, computer-generated forces in a command hierarchy. At each level in the hierarchy, units move toward a goal, selected at a higher level, along paths which combine maintenance of a desired formation with minimization of a penalty integral – some weighted combination of factors such as time, fuel, exposure, attrition, etc. Topics considered are the representation of terrain as a convex polygonal mesh, generalization of the A* pathfinding algorithm to a 2-D surface, fields of extremal paths, flexible formation templates, and synchronization and adaptive replanning.

28200 (UCRL-MA–108964-Rev.1) **PPC user's manual: Revision 1.** Brown, S.A.; Barrett, K.A.; Braddy, D. Lawrence Livermore National Lab., CA (United States). 4 Jan 1993. 32p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93015988. Source: OSTI; NTIS; GPO Dep.

The Portable Process Control library (PPC) is a set of routines to execute and communicate with other processes in environments which permit such operations. The goal is to establish an easy to use interface which can be implemented on a wide variety of platforms. The standard C library I/O interface was taken as a model. In this view, processes are treated as much like files as is possible. In particular, a process is opened and closed as is a file and that means that it is forked by the parent to start with and killed at the end. While a process is open it may be written to and read from with PPC functions which are analogous to the standard C I/O functions fprintf and fgets. In addition, there are functions to monitor the status of the child processes. These do not have precise analogs to file routines, but since the basic interface has been established by the open/close and read/write routines, these have obvious usages.

28201 (UCRL-MA–108966-Rev.1) **PGS user's manual for PGS Version 2.0: Revision 1.** Brown, S.A.; Braddy, D. Lawrence Livermore National Lab., CA (United States). 4 Jan 1993. 69p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93015985. Source: OSTI; NTIS; GPO Dep.

One of the biggest headaches for portability is graphics. The objective evidence is that the field is immature. One cannot exactly say that there are no graphics standards. The real problem is that there are too many standards. PGS is an application program interface (API) that is independent of the underlying host graphics system. All of the graphics portability headaches are confined to PGS and applications which use PGS are completely portable. PGS currently sits on top of X Windows on UNIX platforms, Quickdraw on Macintoshes, and Microsoft's graphics library on DOS platforms. PGS takes a least common denominator approach regarding what graphics functionality it supports. The goal is to run on the widest variety of machines. This model will almost certainly change in time as both graphics hardware and software evolve and become ubiquitous across platforms. PGS structures display surfaces with a viewport defined in normalized coordinates, an enclosing boundary where axes are drawn which is defined as a set of offsets from the viewport window, and a world coordinate system attached to the viewport. The enclosing boundary is useful for obtaining a standoff between rendered data such as line plots and the axes used to measure the rendering. PGS supports both line and text drawing primitives, line and text attributes, and bit maps for handling images and other cell array data. Most functionality in PGS is either primitive operations such as moves and draws or at a very high level such as axis drawing and the rendering algorithms that it supports. These rendering algorithms have two interfaces: one for "raw" data; and one for PML type mappings. This gives a great deal of flexibility to the application developer. PGS has the following rendering algorithms currently: 1D line plots; 2D contour plots; 2D vector plots; 2D image plots; 3D wire frame mesh plots (for 2D data sets); and Grotrian diagram plots.

28202 (UCRL-MA–108967-Rev.1) **ULTRA II user's manual for ULTRA II Revision 3.0: Revision 1.** Brown, S.A.; McMillan, C.F.; Braddy, D.; Keller, P. Lawrence Livermore National Lab., CA (United States). 4 Jan 1993. 74p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93015970. Source: OSTI; NTIS; GPO Dep.

ULTRA II is a program for the presentation, manipulation, and analysis of 1D data sets (i.e., x, y pairs). Presentation refers to the capability to display, and make hard copies of data plots. Manipulation refers to the capability to excerpt, shift, and scale data sets. Analysis refers to the capability to combine data sets in various ways to create new data sets. An example of this is the Fast Fourier Transform (FFT) capability in ULTRA II. The principal object with which ULTRA II works is the curve. A curve is an object which consists of an array of x values, an array of y values, a number of points (the length of the x and y arrays), and an ASCII label. ULTRA II operates on curves. ULTRA II is a portable tool. It runs on machines from supercomputers to PCs. It runs under UNIX, DOS, and MAC OS. Its portability derives from the PACT libraries which provide the portable graphics and the SCHEME interpreter engine which are the main foundation of ULTRA II. ULTRA II can read and write ASCII data files or PDB files with ULTRA curves in them. PDBLib is another PACT tool which provides portable, self-describing, binary data files. PDBLib has specific functionality to write ULTRA curves. This provides an easy and convenient way for applications to produce ULTRA files. The advantage of PDB files over ASCII files is that PDB files are about 1/3 the size of a corresponding ASCII file and can be written or read about 10 times faster. Interested readers will find references to PACT documentation later in this manual.

28203 (UCRL-MA–108975-Rev.1) **PDBDiff user's manual for PDBDiff Version 2.0: Revision 1.** Brown, S.A.; Braddy, D. Lawrence Livermore National Lab., CA (United States). 4 Jan 1993. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93015986. Source: OSTI; NTIS; GPO Dep.

The PACT system provides a number of tools for working with PDB files in a fairly generic fashion. In particular, PDBDiff compares the contents of two PDB files and displays the differences (in a manner similar but not identical to the UNIX utility diff). PDBDiff can also be run in an interactive mode which allows one to compare two PDB files on a variable by variable or even leaf by leaf basis. PDBDiff is an SX program. SX is the SCHEME dialect of the LISP programming language with PACT extensions. The extensions provide functionality for graphics, binary data handling, and other areas of functionality. PDBDiff has a help command which provides information about available commands. Note: The files compared may have been created on or for different target machines. Consequently, a given data type may be represented differently in the two files. In this event values are compared to the precision in the first file, or the precision in the second file, or the precision you specify, whichever is least.

28204 (UCRL-MA–108976-Rev.1) **SCORE user's manual: Revision 1.** Brown, S.A.; Braddy, D. Lawrence Livermore National Lab., CA (United States). 4 Jan 1993. 42p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93015987. Source: OSTI; NTIS; GPO Dep.

PACT is a set of tools to facilitate the development of portable scientific software and to visualize scientific data. As with most constructs, PACT has a foundation. In this case that foundation is SCORE. SCORE (System CORE) has two main functions. The first and perhaps most important is to smooth over the differences between different C implementations and define the parameters which drive most of the conditional compilations in the rest of PACT. Second, it contains several groups of functionality that are used extensively throughout PACT. Although C is highly standardized now, that has not always been the case. Roughly speaking C compilers fall into three categories: ANSI standard; derivative of the Portable C Compiler (Kernighan and Ritchie); and the rest. PACT has been successfully ported to many ANSI and PCC systems. It has never been successfully ported to a system in the last category. The reason is mainly that the "standard" C library supplied with such implementations is so far from true ANSI or PCC standard that PACT would have to include its own version of the standard C library in order to work at all. SCORE's job is to include

the requisite standard headers and ensure that certain key standard library functions exist and function correctly so that, to applications which include the SCORE header(s) and load with SCORE, all C implementations look the same. Once SCORE has been successfully compiled, only the areas of graphics, IPC, and binary data handling require special handling.

28205 (WSRC-IM–90-83-9) **Reviews of computing technology: Object-oriented technology.** Skeen, D.C. Westinghouse Savannah River Co., Aiken, SC (United States). 1 Mar 1993. 56p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93014740. Source: OSTI; NTIS; GPO Dep.

A useful metaphor in introducing object-oriented concepts is the idea of a computer hardware manufacturer assembling products from an existing stock of electronic parts. In this analogy, think of the parts as pieces of computer software and of the finished products as computer applications. Like its counterpart, the object is capable of performing its specific function in a wide variety of different applications. The advantages to assembling hardware using a set of prebuilt parts are obvious. The design process is greatly simplified in this scenario, since the designer needs only to carry the design down to the chip level, rather than to the transistor level. As a result, the designer is free to develop a more reliable and feature rich product. Also, since the component parts are reused in several different products, the parts can be made more robust and subjected to more rigorous testing than would be economically feasible for a part used in only one piece of equipment. Additionally, maintenance on the resulting systems is simplified because of the part-level consistency from one type of equipment to another. The remainder of this document introduces the techniques used to develop objects, the benefits of the technology, outstanding issues that remain with the technology, industry direction for the technology, and the impact that object-oriented technology is likely to have on the organization. While going through this material, the reader will find it useful to remember the parts analogy and to keep in mind that the overall purpose of object-oriented technology is to create software parts and to construct applications using those parts.

9903 Information Handling

Refer also to citation(s) 25697, 25881, 25884, 25989, 26209, 26352, 26406, 26449, 26450, 26474, 26766, 26908, 26916, 27102, 27123, 27268, 27279, 27293, 27295, 27296, 27441, 27446, 27533, 28148, 28149, 28153, 28159, 28166

28206 (DOE/AD–0043) **Information resources management long-range plan, FY1994–1998.** USDOE Office of Information Resources Management, Washington, DC (United States). Apr 1993. 145p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93013898. Source: OSTI; NTIS; INIS; GPO Dep.

This document describes IRM activities and the information technology resources and capabilities of the Department, the future requirements, and the strategies and plans to satisfy the identified requirements. The long-range planning process provides the systematic means to meet this objective and assists the Department in assuring that information technology (IT) support is provided in an efficient, effective, and timely manner so that its programmatic missions can be accomplished. Another important objective of the Plan is to promote better understanding, both within and external to the Department, of its IT environment, requirements, issues, and recommended solutions. This DOE IRM Plan takes into consideration the IRM requirements of approximately 50 different sites. The annual long-range planning cycle for supporting this Plan was initiated by a Call in August 1991 for site plans to be submitted in February 1992 by those Departmental components and contractors with major IRM requirements.

28207 (DOE/AD–0044) **Information Technology Resources Assessment.** USDOE Office of Information Resources Management, Washington, DC (United States). Apr 1993. 70p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93013899. Source: OSTI; NTIS; GPO Dep.

The Information Technology Resources Assessment (ITRA) is being published as a companion document to the Department of Energy (DOE) FY 1994–FY 1998 Information Resources Management Long-Range Plan. This document represents a collaborative effort between the Office of Information Resources Management and the Office of Energy Research that was undertaken to achieve, in part, the Technology Strategic Objective of IRM Vision 21. An integral part of this objective, technology forecasting provides an understanding of the information technology horizon and presents a perspective and focus on technologies of particular interest to DOE program activities. Specifically, this document provides site planners with an overview of the status and use of new information technology for their planning consideration.

28208 (DOE/MA/33222–T1) **Emerging technologies planning guide, 1993 edition.** USDOE Office of Administration and Human Resource Management, Washington, DC (United States). DOE-Wide Project Support Branch; Computer Data Systems, Inc., Germantown, MD (United States). Nov 1992. 57p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC01-88MA33222. Order Number DE93017196. Source: OSTI; NTIS; GPO Dep.

Information system technology enhancements during the next five years are expected to provide some of the most significant individual and organization work improvements ever made in the office environment. This guide is an aid to planning these technologies and assessing their roles in improving the effectiveness of Headquarters programs. Their implementation will cost-effectively support Departmental operations and the National Energy Strategy. At the hear of this process is an understanding of the relationship which exists between technology introduction and the planning, budgeting and acquisition process. The 1993 edition of this guide covers the 1993–1997 time frame.

28209 (FEI–2035) **ENSDF file nuclear data for application problems.** Grudzevich, O.T.; Zelenetskij, A.V.; Pashchenko, A.B. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk (Russian Federation). Fiziko-Ehnergeticheskij Inst. 1989. [23p.] (In Russian). Order Number DE93629816. Source: OSTI; NTIS (US Sales Only); INIS.

Specialized targeted data libraries are prepared on the basis of ENSDF file of 1989 version; the libraries include the file of spectra of discrete levels and statistic characteristics of excited nuclei and the file of spectroscopic data for activation analysis. Data representation formats in this files are discussed. 7 refs.; 4 tabs.

28210 (FEI–2043) **BOSPOR library software: CSCHANGE program.** Grudzevich, O.T.; Zelenetskij, A.V.; Pashchenko, A.B. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk (Russian Federation). Fiziko-Ehnergeticheskij Inst. 1989. [13p.] (In Russian). Order Number DE93629817. Source: OSTI; NTIS (US Sales Only); INIS.

The CSCHANGE program designed for correction and processing of the BOSPOR library data in the interactive mode using the personal computer is presented. The program is written in FORTRAN-77 and installed at IBM PC XT/AT and compatible computers. 6 refs.; 3 tabs.

28211 (FEI–2055) **Comparative analysis of systematics on (n,p) reaction cross sections at neutron energy ≃14-15 MeV.** Badikov, S.A.; Pashchenko, A.B. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk (Russian Federation). Fiziko-Ehnergeticheskij Inst. 1989. [17p.] (In Russian). Order Number DE93629818. Source: OSTI; NTIS (US Sales Only); INIS.

Comparative analysis of systematics of (n,p) reaction cross sections is performed for En≈14.5 MeV using data library compiled on the basis of the results of experiments which were published before 1990. Refined values of systematic parameters, recommended values of cross sections and errors are presented. 21 refs.; 2 tabs.

28212 (JINR-R–10-92-5) **The usage of the data base for the experimental data mass processing control.** Ivanov, V.G.; Ehrdehnehdehlgehr, T. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Computing Techniques and Automation. 1992. [11p.] (In Russian). Order Number DE93629815. Source: OSTI; NTIS (US Sales Only); INIS.

A system for organizing and using the data base concerning the origin of the problem and data running during experimental data mass processing is considered. The personal computer compatible with IBM PC/XT/AT is required for operating the system. 4 refs.; 4 figs.

28213 (LBL–32165-Rev.3) **Public census data on CD-ROM at Lawrence Berkeley Laboratory: Revision 3.** Merrill, D.W. Lawrence Berkeley Lab., CA (United States). 16 Jan 1993. 44p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. Order Number DE93015292. Source: OSTI; NTIS; GPO Dep.

The Comprehensive Epidemiologic Data Resource (CEDR) and Populations at Risk to Environmental Pollution (PAREP) projects, of the Information and Computing Sciences Division (ICSD) at Lawrence Berkeley Laboratory (LBL), are using public socioeconomic and geographic data files which are available to CEDR and PAREP collaborators via LBL's computing network. At this time 72 CD-ROM diskettes (approximately 37 gigabytes) are on line via the Unix file server "cedrcd.lbl.gov". Most of the files are from the US Bureau of the Census, and many of these pertain to the 1990 Census of Population and Housing. All the CD-ROM diskettes contain documentation in the form of ASCII text files. In addition, printed documentation for most files is available for inspection at University of California Data and Technical Assistance (UC DATA), tel. (510) 642-6571, or the UC Documents Library, tel. (510) 642-2569, both located on the UC Berkeley Campus. Many of the CD-ROM diskettes distributed by the Census Bureau contain software for PC compatible computers, for easily accessing the data. Shared access to the data is maintained through a collaboration among the CEDR and PAREP projects at LBL, and UC DATA, and the UC Documents Library. LBL is grateful to UC DATA and the UC Documents Library for the use of their CD-ROM diskettes. Shared access to LBL facilities may be restricted in the future if costs become prohibitive. Via the Sun Network File System (NFS), these data can be exported to Internet computers for direct access by the user's application program(s). Due to the size of the files, this access method is preferred over File Transfer Protocol (FTP) access. Please contact Deane Merrill (dwmerrill@lbl.gov) if you wish to make use of the data.

28214 (SAND–93-0869C) **Making the connection between information modeling and implementation.** Eaton, M.J. Sandia National Labs., Albuquerque, NM (United States). [1993]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9305161–2: INGRES world '93 conference, Santa Clara, CA (United States), 9-13 May 1993). Order Number DE93011588. Source: OSTI; NTIS; GPO Dep.

Over the past several years the Information Technology Department at Sandia Laboratories has developed information systems based on a solid foundation of information modeling and data administration. The output of the information modeling efforts is a fifth normal form relational table structure and associated data constraints. Developers would then implement the system by creating end-user application software. Traditionally, the development process combined the code necessary for maintaining data constraints with the code to provide the user interface (i.e. forms, windows, etc.). This approach has an adverse effect on the maintainability of the software as the system (i.e. the information model) changes over time. This paper will discuss the application of a direct connection between the information model and the implementation of a database with associated code to maintain required data constraints. The automated generation of this code allows the developers to concentrate on the user interface code development. The technique involves generating database procedure code automatically from the information modeling process. The database procedure code will enforce the data constraints defined in the information model. This has resulted in a fully functional database with complete rules enforcement within days of a completed information model. This work used the Knowledge Management Extensions of the Ingres database software. Changes to the architecture of both Application By Forms (ABF) and Ingres Windows4GL client applications required by this process will also be discussed.

28215 (WHC-SA–1781) **The evolving roles of technical communicators within a government project: The Hanford Site.** Forbes, C.J. Westinghouse Hanford Co., Richland, WA (United States). Jun 1993. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (CONF-930630–2: Society for Technical Communication conference, Dallas, TX (United States), 10-13 Jun 1993). Order Number DE93014588. Source: OSTI; NTIS; GPO Dep.

This presentation describes the present-day workplace for technical communicators at the United States Department of Energy's Hanford Site. Factors that are significantly affecting the Hanford Site workplace are identified, with emphasis on the effects of these factors on the workplace activities of Hanford Site technical communication professionals.

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28216 (IAEA-TECDOC–703) **Guidelines for IAEA International Regulatory Review Teams (IRRTs).** International Atomic Energy Agency, Vienna (Austria). Apr 1993. [47p.] Order Number DE93631721. Source: OSTI; NTIS (US Sales Only); INIS.

This document is intended to be used by International regulatory review teams in reviewing the activities of a regulatory body as applicable to the regulation of nuclear power plants. The mission will, however, take note of any other activities of the regulatory body when drawing up the review report. The document does not specifically deal with the functions of a regulatory body responsible for other types of nuclear facilities or related nuclear activities, but it is intended that the concepts presented in the document could be applied where appropriate. Refs.

28217 (INIS-mf–12758, pp. 171-175) **Quality assurance programmes and normalization for the Argentine-Brazilian integration.** Biernat, A.E. (Empresa Nuclear Argentina de Centrales Eiectricas SA (ENACE), Buenos Aires (Argentina)). Asociacion Argentina de Tecnologia Nuclear, Buenos Aires (Argentina). 1987. [735p.] (In Spanish). (CONF-8711355–: 15. scientific meeting and 4th Latin American meeting and 1st sessions on nuclear power plants, San Carlos de Bariloche (Argentina), 2-6 Nov 1987). In *Proceedings of the fifteenth scientific meeting; fourth Latin American meeting; first sessions on nuclear power plants.* Order Number DE91003052. Source: OSTI; NTIS (US Sales Only); INIS.

Within the frame of the tasks developed by the Argentine-Brazilian Contractors Coordination Committee in the nuclear area, which was at the beginning promoted by the Contractor Committee of the Argentine Association of Nuclear Technology, a working team was created between both countries in order to analyze the existing regulations and the Quality Assurance systems applied in Brazil and Argentina for their nuclear projects. This paper describes the steps to be followed so as to fulfill the compatibility of the rules, quality assurance and firm certification, laboratories, personnel and materials, and the applicable quality assurance programmes. At first, the methodology applied was the collection of the information and the existing regulations in each one of the countries, to exchange them, analyze them and arrange joint meetings and organize a seminar with experts from both countries to develop and discuss the objectives of this working team. As a result of these activities, the criteria adopted will allow, together with another actions, that both Argentine and Brazilian firms make exchanges and integrations in the nuclear field to supply Atucha II and Angra II. (Author).

28218 (INIS-mf–12758, pp. 176-181) **Relevant aspects of a quality assurance program applied to a nuclear power plant operation.** Fernandez, J.C. (Comision Nacional de Energia Atomica, Embalse (Argentina). Central Nuclear en Embalse). Asociacion Argentina de Tecnologia Nuclear, Buenos Aires (Argentina). 1987. [735p.] (In Spanish). (CONF-8711355–: 15. scientific meeting and 4th Latin American meeting and 1st sessions on nuclear power plants, San Carlos de Bariloche (Argentina), 2-6 Nov 1987). In *Proceedings of the fifteenth scientific meeting; fourth Latin American meeting; first sessions on nuclear power plants.* Order Number DE91003052. Source: OSTI; NTIS (US Sales Only); INIS.

The purpose of this work was to enumerate the most relevant subjects to be taken into account for the elaboration of a Quality Assurance Program aimed to regulate a nuclear power plant operation. At first, it was necessary to point out the relevance that

implies the presence of a group of personnel, experienced in quality assurance with enough knowledge on the technical and organizing aspects of the plant. Other aspect to be taken into account was the contemplation of the international requirements, through the International Atomic Energy Agency and of the national requirements that each country had set up by the corresponding regulating agencies. These organizations pointed out the minimum rules that must be followed for the adequate and efficient execution of a program. The Quality Assurance Manual and the program and work procedures constituted the Quality Assurance Program which must be checked as regards its fulfillment by auditors and quality assurance supervisions. (Author).

Corporate Author Index

This index lists the corporate authors responsible for issuing the documents in this publication which are identified primarily by report number. The corporate names are entered in standardized forms as defined in ETDE/PUB–3, *International Energy: Research Organizations 1986–1990*. Each entry under a corporate name includes the document title and citation number. Three items of information may appear in parentheses: (1) an abbreviation to identify the document type, such as a report; (2) the country of publication, indicated by International Organization for Standardization (ISO) country code; and (3) the language of the document if non-English (R;CA;In French). Author affiliations are not listed in this index.

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ECOTEC Research and Consulting Ltd., Birmingham (United Kingdom)
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EG and G Energy Measurements, Inc., Goleta, CA (United States). Santa Barbara Operations
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Interpretation of risk significance of passive component aging using probabilistic structural analysis, 18:26353 (R;US)
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Probabilistic based design rules for intersystem LOCAS in ABWR piping, 18:26351 (R;US)
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Summary report of project SIREN (Search, Intercept, Retrieve, Expulsion, Nuclear), 18:25702 (R;US)
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Test plan for the field evaluation and demonstration of the Contamination Control Unit, 18:25864 (R;US)
The NUCLARR databank: Human reliability and hardware failure data for the nuclear power industry, 18:26352 (R;US)
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Hydrogen peroxide safety issues, 18:27661 (R;US)
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Compiling models into real-time systems, 18:26130 (R;FR;In French)
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Development of RCM methodology and tools for EDF nuclear power plants, 18:26129 (R;FR;In French)
Human reliability and human factors in complex organizations: epistemological and critical analysis - practical avenues to action, 18:26255 (R;FR;In French)

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ENEA, Camugnano (Italy). Centro Ricerche Energia Brasimone - Area Nucleare
Reactivity and corrosion properties of metallic lithium candidate blanket breeder for fusion reactors, 18:28059 (R;IT)

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Experimental results of wind powered pumping plant with electrical transmission, 18:26068 (R;IT)
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Optimisation procedures using 'eye' merit function, 18:26939 (R;IT)
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Utilization of low temperature geothermal water in traditional and advanced agricultural applications, 18:26049 (R;IT)

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Composite Si/C/N powder production by laser induced gas phase reactions, 18:26793 (R;IT)
Correlation between X-ray diffraction line profile analysis and solid state reactions induced by mechanical alloying of elemental powders, 18:26607 (R;IT)
Evaluation of trace and minor elements in agricultural products from Italian farms, by instrumental neutron activation analysis, 18:27407 (R;IT)
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There is future for present generation of artificial neural networks, 18:28145 (R;IT)

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Application of reconstructive MHD code based on formalism of toroidal multipoles to iter tokamak, 18:27971 (RA;IT)
ArF laser deposited tin oxide films studied by 'in situ' surface analysis techniques, 18:26795 (R;IT)
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Impurity screening in high density plasmas in tokamaks with limiter configuration, 18:27967 (RA;IT)
Ion Bernstein wave propagation and absorption in general magnetic field configuration, 18:27977 (R;IT)
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Linear and nonlinear stability of toroidal Alfven eigenmodes, 18:27982 (R;IT)
Model for linear and non-linear stages of 2-D Rayleigh-Taylor instability, 18:27984 (R;IT)
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Occupational radiation dose assessment process at research thermonuclear fusion plant, 18:28043 (RA;IT)
Optimization of FTU toroidal limiter shape, 18:28048 (RA;IT)
Possibility of achieving very good confinement in compact high-field tokamaks, 18:27985 (R;IT)
Pressure anisotropy in ohmic FTU discharges, 18:27956 (RA;IT)
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Properties of ablation cloud surrounding solid hydrogen pellets injected in tokamaks, 18:28041 (RA;IT)
Radiation protection at Frascati neutron generator, 18:27045 (RA;IT)
Role of feedback in evolution of double layers, 18:27965 (RA;IT)
Role of parametric decay instabilities and edge plasma fluctuations on current drive efficiency of lower hybrid waves, 18:27953 (RA;IT)
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Spatial diffusion of fast electrons during 2.45 GHz experiment on ASDEX, 18:27959 (RA;IT)
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Threshold of ion temperature gradient driven mode, 18:27969 (RA;IT)
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Progress in excimer lasers, 18:26935 (R;IT)
Saturation and cavity losses optimization in free electron lasers, 18:26941 (R;IT)
Use of NAG routines for numerical simulation of free electron laser, 18:26937 (R;IT)

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Structural and electrical properties of highly conductive microcrystalline Si(P) layers, 18:25998 (R;IT)

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Environmental conservation by radiation technology: New Italian multi-purpose demonstration centre, 18:27046 (R;IT)
Project evaluation and monitoring system (SVEN): Multi-criteria algorithm, 18:28143 (R;IT;In Italian)

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MePER (Methodology in support of Regional Energy Programming), 18:26474 (R;IT;In Italian)
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Option of sea-dumping and presentation of CRESP's results, 18:25706 (R;IT)

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Development of beryllium bonds for plasma-facing components, 18:28044 (R;IT)

Energy Consultants, Inc., Las Cruces, NM (United States)
Workshop on electric utility systems modeling, 18:26398 (R;US)

Energy International, Inc., Pittsburgh, PA (United States)
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Tidal stream energy review, 18:26052 (R;GB)
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EQE Engineering Consultants, Irvine, CA (United States)
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EQE Engineering Consultants, San Francisco, CA (United States)
Methods used for the treatment of non-proportionally damped structural systems, 18:26365 (R;US)

European Bank for Reconstruction and Development, London (United Kingdom)
Energy operations policy, 18:26219 (I;XA)
Environmental management: The bank's policy approach, 18:26417 (I;XA)
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Exploration Resources, Inc., Athens, GA (United States)
The Savannah River Site's Groundwater Monitoring Program: Third quarter 1992, 18:27406 (R;US)

Exploratorium, San Francisco, CA (United States)
Exhibit-based energy teaching at the Exploratorium: Final report, September 1, 1991–August 31, 1992, 18:28071 (R;US)

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The consequences for water purifying plants of using smooth water in district heating transmission systems, 18:26549 (R;DK;In Danish)

Fermi National Accelerator Lab., Batavia, IL (United States)
A fast ring-imaging Cherenkov counter for a fixed-target heavy-quark experiment, 18:27187 (R;US)
A search for scalar leptoquarks in D0, 18:27777 (R;US)
Alternate manufacturing processes and materials for the SSC dipole magnet coil end parts, 18:27048 (R;US)
Automatic differentiation of limit functions, 18:27003 (R;US)
Dead material and energy measurements in hadronic calorimeters, 18:27188 (R;US)
Direct photon production from D0, 18:27776 (R;US)
Direct photon results from CDF, 18:27781 (R;US)
Experience with the Source Evaluation Board method of procuring technical components for the Fermilab Main Injector, 18:27052 (R;US)
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High counting rate resistive-plate chamber, 18:27190 (R;US)
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Low energy response of the D0 calorimeter and jet energy measurement, 18:27186 (R;US)
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Observation of the coalescing of beam into an asymmetric rf bucket by stochastic cooling, 18:27001 (R;US)
Quark and gluon jets at CDF, 18:27775 (R;US)
Redshift distortions of galaxy correlation functions, 18:27702 (R;US)
Sampling nonuniformity in the SDC calorimeter EM/HAD boundary, 18:27189 (R;US)
SSC 50 mm dipole magnet cryostat thermal measurement results, 18:27050 (R;US)
Study of stability of beam in the Fermilab main injector, 18:27049 (R;US)
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The Dv upgrade silicon tracker, 18:27185 (R;US)

The design and performance of a high sensitivity loss monitor system for use in the Fermilab antiproton rings, 18:27051 (R;US)
Transition crossing in the Fermilab Main Ring, past and present, 18:27000 (R;US)
Travel to Aachen, Germany, to attend the conference on recent developments and applications of the theory of quantum chromodynamics entitled "QCD – 20 years later": Foreign trip report, June 5–18, 1992, 18:27749 (R;US)
Two jet energy and rapidity distributions, 18:27779 (R;US)
W and Z decays to electrons in D0, 18:27780 (R;US)
[Travel to Germany and Switzerland to discuss the progress and further development of the TESLA collaboration, and to present a paper and attend the European particle accelerator conference in Berlin, under the auspices of the Technische Hochschule Berlin]: Foreign trip report, March 17–April 5, 1992, 18:27044 (R;US)
[Travel to La Plata, Argentina, to attend as external examiner the Ph.D. examination of now Dr. Antonio Bouzas and to hold discussions on the organization of the next ELAF 1993]: Foreign trip report, September 5–19, 1992, 18:27774 (R;US)

Finnish Centre for Radiation and Nuclear Safety (STUK), Helsinki (Finland)
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Forest Service, Aiken, SC (United States). Southeastern Forest Experiment Station
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Fraunhofer-Institut fuer Kurzzeitdynamik - Ernst-Mach-Institut (EMI), Freiburg im Breisgau (Germany)
Comparison of HOB curves for 0.5-g NP charges with field test data and calculations, 18:27247 (R;US)

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An investigation of the levels of electromagnetic radiation generated by wind turbines, 18:26065 (R;GB)
The effect of rotor characteristics on loading and fatigue life of a WTG in a wind farm, 18:26082 (R;GB)

Gas Research Inst., Chicago, IL (United States)
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General Atomics, San Diego, CA (United States)
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Dimensionally similar discharges with central rf heating on the DIII-D tokamak, 18:27990 (R;US)
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Thin Ni silicide formation by low temperature-induced metal atom reaction with ion implanted amorphous silicon, 18:26740 (R;US)
Trace contaminant determination in fish scale by laser ablation technique, 18:27476 (R;US)
Travel to attend a meeting in Austria to discuss issues related to criticality safety and overpacks in the transport of radioactive material: Foreign trip report, August 30–September 5, 1992, 18:26904 (R;US)
Travel to attend symposium on swift heavy ions in matter, a conference on electrostatic accelerators and associated boosters and a conference on applications of nuclear techniques: Foreign trip report, May 16–June 21, 1992, 18:27091 (R;US)
Travel to collect data on boiling water reactor (BWR) instability events in Sweden and Spain: Trip report, May 4–14, 1992, 18:26372 (R;US)
Travel to England and the Netherlands for a performance evaluation of scanning and electron microscopes equipped with field emission guns: Foreign trip report, April 27–May 5, 1993, 18:27220 (R;US)
Travel to France for a large experiment at the GANIL accelerator facility: Foreign trip report, June 10–24, 1992, 18:27092 (R;US)

Travel to Germany for conference on nuclei far from stability and conference on atomic masses and fundamental constants: Foreign trip report, July 18–26, 1992, 18:27826 (R;US)
Travel to Germany to attend the international conference on defects in insulating materials: Foreign trip report, August 14–31, 1992, 18:26765 (R;US)
Travel to Germany to work on off-site assignment at the Clinic for Nuclear Medicine at the University of Bonn, Germany, for a one-year period through support as a Senior American Scientist of the Alexander von Humboldt Foundation of Germany: Foreign trip report, June 10, 1991–June 4, 1992, 18:27528 (R;US)
Travel to Grenoble, France, to attend and present two papers at the 1992 IEEE international conference on robotics and automation, and to visit three French robotics research laboratories (INRIA, LAAS, and LIFIA): Foreign trip report, May 8–24, 1992, 18:26903 (R;US)
Travel to Japan for a performance evaluation of the Hitachi HF2000 cold field emission gun analytical electron microscope: Foreign trip report, May 16–22, 1993, 18:27221 (R;US)
Travel to Japan to participate in the international seminar on high-resolution STEM: Foreign trip report, June 9–16, 1992, 18:26851 (R;US)
Travel to London, England, to attend the sixth international conference on road traffic monitoring and control and to visit traffic control centers in Greater London area to assess their capabilities and operations: Foreign trip report, March 20, 1992–May 1, 1992, 18:26519 (R;US)
Travel to Luso, Portugal, to participate in the NATO Advanced research workshop on the use of biomarkers to assess human health and environmental impacts from exposure to chemical pollutants: Foreign trip report, May 30, 1992–June 9, 1992, 18:27650 (R;US)
Travel to The Netherlands for activities of the International Energy Agency's Heat Pump Centre: Foreign trip report, October 11–19, 1991, 18:26532 (R;US)
Travel to the Netherlands to participate in a workshop held by the World Inventory of Soil Emissions (WISE) project at the International Soil Reference and Information Centre (ISRIC): Foreign trip report, August 22–29, 1992, 18:27439 (R;US)
Travel to the United Kingdom and Italy to present keynote lectures and technical talks at two international meetings on the role of natural organic matter in the environment and to learn about recent advances in this area relevant to the traveler's research: Foreign trip report, September 10–26, 1992, 18:27440 (R;US)
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[Environmental impact analyses on current and planned Antarctic operations and research activities]: Foreign trip report, October 19–November 20, 1992, 18:27444 (R;US)
[Life Management of Nuclear Power Plants]: Foreign trip report, February 15–22, 1992, 18:26243 (R;US)
[Rothamsted model for turnover of soil organic matter]: Foreign trip report, October 7–9, 1992, 18:27441 (R;US)
[Transportation/geologic repository interface requirements for high level radioactive waste and spent nuclear fuel]: Foreign trip report, November 7–24, 1992, 18:25736 (R;US)
[Travel to Bermuda to participate in the North Atlantic Treaty Organization (NATO) advanced research workshop on biogeochemical ocean-atmosphere transfers]: Foreign trip report, January 26–31, 1992, 18:27499 (R;US)
[Travel to Japan for collaborative research on DNA repair]: Foreign trip report, September 17–December 30, 1991, 18:27518 (R;US)
[Travel to Japan to attend the fifth international symposium on advanced nuclear energy research and to visit the new research reactor JRR-3M]: Foreign trip report, March 9–12, 1993, 18:25920 (R;US)
[Travel to US field stations in Antarctica in preparation for environmental impact studies]: Foreign trip report, January 4–February 22, 1993, 18:27445 (R;US)

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RCRA closure plan for the Bear Creek Burial Grounds B Area and Walk- In Pits at the Oak Ridge Y-12 Plant, Oak Ridge, Tennessee, 18:25695 (R;US)

Oesterreichisches Forschungszentrum Seibersdorf GmbH (Austria)
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Theory, modeling, and simulation annual report, 1992, 18:27879 (R;US)
Travel to France and Germany to present a paper and attend IAU/ICSU/UNESCO exposition on the adverse environmental impacts on astronomy and attend workshop at IFU/FhG: Foreign trip report, June 26–July 12, 1992, 18:27322 (R;US)
Travel to Paris, France to attend the IAEE meeting and to present a paper on the method and the results of import substitution using alternative import vectors for the United States, France and Japan: Foreign trip report, May 17–24, 1992, 18:26413 (R;US)
TWEAT: Ternary Waste Envelope Assessment Tool, 18:25746 (R;US)
UV and IR laser ablation for inductively coupled plasma mass spectrometry, 18:25748 (R;US)
Valuing the salmon resource: Columbia River stocks under climate change and fishery enhancement, 18:27505 (R;US)
Water level measurements for modeling hydraulic properties in the 300-FF-5 and 100 Aggregate Area Operable units, 18:27454 (R;US)
Western Area Power Administration customer database, 18:26470 (R;US)
[A meeting in Finland on innovative low-energy concepts for the year 2025]: Foreign trip report, August 30–September 6, 1992, 18:26501 (R;US)
[Travel to 8th international conference on ion beam modification of materials to present one unclassified paper and attend conference sessions]: Foreign trip report, September 5–12, 1992, 18:25913 (R;US)
[Travel to Austria for a conference on visibility and fine particles]: Foreign trip report, September 13–20, 1992, 18:27323 (R;US)

Pacific Northwest Lab., Richland, WA (United States). Environmental Management Operations
Shemya AFB, Alaska 1992 IRP field investigation report: Volume 2, Appendix A: Final report, 18:27404 (R;US)

Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire
Spectroscopic measurements using isotope separator on-line facilities, 18:27823 (R;FR)

Paris-11 Univ., 91 - Orsay (France). Lab. de l'Accelerateur Lineaire
Higgs boson searches at LEP 1, 18:27805 (R;FR)
RF system options for the τ-C factory, 18:26967 (R;FR)
The perturbative QCD prediction to R_τ revisited, 18:27789 (R;FR)

Paris-7 Univ., 75 (France)
Transport in a fusion plasma in presence of a chaotic magnetic field, 18:27989 (R;FR;In French)

Parsons (Ralph M.) Co., Pasadena, CA (United States)
Catalytic reduction of SO_x-NO_x in coal flue gas: Supplement to the final report, 18:26110 (R;US)

Paul Scherrer Inst. (PSI), Villigen (Switzerland)
Albedo measurements and system investigation of a grid-connected photovoltaic plant on Mount Titlis, 18:26005 (R;CH;In German)
Photochemical modelling of photo-oxidant levels over the Swiss plateau and emission reduction scenarios, 18:26461 (R;CH)
Reactors 2000: consultation on the technical and economical requirements connected with the possible realization of nuclear installations in Switzerland after the year 2000: Report of the committee, 18:26447 (R;CH;In French)
The economics of global warming, 18:26435 (R;CH)

Pennsylvania State Univ., University Park, PA (United States)
Fundamental studies on passivity and passivity breakdown, 18:26606 (R;US)
Prediction of pitting damage functions for condensing heat exchangers, 18:26500 (R;US)

Pennsylvania State Univ., University Park, PA (United States). Center for Advanced Materials
Critical issues in the use of metals and alloys in sulphur-containing aqueous systems, 18:26604 (R;US)
Modeling the corrosion behaviors of the heat transport circuits of light water nuclear reactors, 18:26227 (R;US)

The deterministic prediction of failure of low pressure steam turbine disks, 18:26225 (R;US)
The deterministic prediction of damage functions to low pressure steam turbines, 18:26226 (R;US)
Vacancy condensation as the precursor to passivity breakdown, 18:26605 (R;US)
[Fundamental studies of passivity and passivity breakdown], 18:26603 (R;US)

Pernambuco Univ., Recife, PE (Brazil). Dept. de Energia Nuclear
Determination of thermodynamic properties and stability limit from fluorite phase of uranium and lanthanide mixed oxides, using galvanic cells with solid electrolytes, 18:26753 (I;BR;In Portuguese)

Pittsburgh Univ., PA (United States)
Computer simulations for the adsorption of polymers onto surfaces: Progress report, 18:26788 (R;US)
New infrared photon absorption processes: Final technical progress report, August 1, 1988–February 1, 1993, 18:27882 (R;US)

Pittsburgh Univ., PA (United States). Dept. of Chemical and Petroleum Engineering
Effect of pretreating of host oil on coprocessing: Quarterly progress report, January 1, 1993–March 31, 1993, 18:25538 (R;US)

Pittsburgh Univ., PA (United States). Dept. of Chemistry
Quantum state resolved desorption of CO from solid surfaces: Final technical report, 18:26859 (R;US)

Pittsburgh Univ., PA (United States). Dept. of Physics and Astronomy
Signal processing for liquid ionization calorimeters, 18:27174 (R;US)

Politecnico di Torino, Turin (Italy)
Impurity screening in high density plasmas in tokamaks with limiter configuration, 18:27967 (RA;IT)

Portland Energy Conservation, Inc., OR (United States)
Building commissioning guidelines: Second edition, 18:26498 (R;US)

Powergen plc, London (United Kingdom)
Report and accounts 1992, 18:26113 (R;GB)

Princeton Univ., NJ (United States)
Power and particle control in the Tokamak Physics Experiment divertor, 18:28057 (R;US)
[Transport properties of disordered porous media from the microstructure]: Progress report, March 1989–June 1993, 18:26784 (R;US)

Princeton Univ., NJ (United States). Plasma Physics Lab.
Experimental exploration of profile control in the Princeton Beta Experiment-Modified (PBX-M) tokamak, 18:28020 (R;US)
Fast wave direct electron heating in TFTR, 18:28023 (R;US)
Investigation of electrostatic waves in the ion cyclotron range of frequencies in L-4 and ACT-1, 18:28019 (R;US)
Numerical simulation of Bootstrap Current, 18:28021 (R;US)
The mission and physics design of TPX, 18:28058 (R;US)
Theory of kinetic ballooning modes excited by energetic particles in tokamaks, 18:28022 (R;US)
Threshold of ion temperature gradient driven mode, 18:27969 (RA;IT)

PSI Technology Co., Andover, MA (United States)
Transformations of inorganic coal constituents in combustion systems: Volume 1, sections 1–5: Final report, 18:25571 (R;US)
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Qatar General Petroleum Corporation, Doha (Qatar)
The natural gas resources and industrial development in Qatar, 18:25616 (I;QA)

Qatar Univ., Doha (Qatar). Dept. of Physics
Some improvement of charcoal measurement techniques used for indoor radon measurements in Qatar, 18:27341 (R;QA)

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Ramboell, Hannemann og Hoejlund A/S, Copenhagen (Denmark)
Central heating in older housing blocks, 18:26550 (R;DK;In Danish)

Reading Univ. (United Kingdom). Centre for Agricultural Strategy
Farmers' current attitudes to energy forestry in Great Britain, 18:25970 (R;GB)

Rensselaer Polytechnic Inst., Troy, NY (United States)
Stabilization of high T_c superconductivity in cadmium sulfide: Final report, 18:26787 (R;US)

Resources Engineering Systems, Inc., Cambridge, MA (United States)
Multi-Site Project seismic verification experiment and assessment of site suitability, 18:25614 (R;US)

Resources for the Future, Inc., Washington, DC (United States)
Above Bonneville passage and propagation cost effectiveness analysis: Technical report, January 1993, 18:25990 (R;US)

Rice Univ., Houston, TX (United States). Dept. of Physics
Quasi-elastic neutron scattering studies of protein dynamics: Progress report, November 1, 1992–May 25, 1993, 18:27909 (R;US)

Risoe National Lab., Roskilde (Denmark)
Environmental Science and Technology Department annual report 1992, 18:28086 (R;DK)

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Using the distributed activation energy model to interpret oxidative coal pyrolysis experiments performed by flat-flame burner, entrained-flow reactor and thermogravimetric analyzer, 18:25544 (R;DK)

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Predicted effects of countermeasures on radiation doses from contaminated food, 18:27636 (R;DK)

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Abstracts of Nordisk Ministerraads workshop on high temperature electrode materials, 18:26484 (R;DK)
Electrode kinetics of SOFC anodes and cathodes, 18:26492 (RA;DK)
Exact solutions to Kroeger-Vink diagrams for perovskites, 18:26485 (RA;DK)
Impedance spectroscopy applied on sofc-related problems, 18:26489 (RA;DK)
Lithium accumulator: Report on work carried out 1992-3, 18:26404 (RA;DK;In Danish)
Lithium accumulators: Final report, 18:26402 (R;DK;In Danish)
Methane oxidation on oxide catalysts, 18:26491 (RA;DK)
On the measurement and interpretation of transport properties of mixed conductors, 18:26490 (RA;DK)
On the SOFC cathode reaction, 18:26495 (RA;DK)
Oxide ion conduction and mixed conduction in $LaTa_3O_9$, $Ba_6Ta_2O_{11}$ and $Ca_{12}Al_{14}O_{33}$, 18:26487 (RA;DK)
Precipitation of LiCl and Li from SO_2- and SO_2Cl_2-catholyte: Working report on Li accumultor project, 18:26403 (RA;DK;In Danish)
Stoichiometry and structure of $(La,Sr)MnO_3$, 18:26486 (RA;DK)
Surface oxygen exchange kinetids of solid oxide ion conductors, 18:26488 (RA;DK)
Swedish research on MCFC, 18:26494 (RA;DK)
The Statoil SOFC program, 18:26493 (RA;DK)

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Organic superconductors, 18:26768 (RA;DK)

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Towards spectroscopy of partially coherent sources, 18:27881 (R;US)

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Central heating in older housing blocks, 18:26550 (R;DK;In Danish)

Rogers and Associates Engineering Corp., Salt Lake City, UT (United States)
Assessment of greater-than-Class C waste at Los Alamos National Laboratory, 18:25724 (R;US)

Low-level radioactive waste disposal facility fee schedules, 18:25691 (R;US)

Rome Univ. (Italy)
Monitoring program for evaluation of pollution level of Italian harbour sediments: General description, 18:27489 (R;IT)

Rome Univ. (Italy). Dipt. di Fisica
Measure of radiation damage induced by gamma-rays source on organic scintillators and its recovery time, 18:27182 (R;IT)

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ArF laser deposited tin oxide films studied by 'in situ' surface analysis techniques, 18:26795 (R;IT)
F center-molecular ion couples in alkali halides: Magneto-optics study (part two). Spin lattice relaxation time and electron spin memory, 18:26794 (R;IT;In Italian)

Royal Inst. of Tech., Stockholm (Sweden). Dept. of Applied Electrochemistry and Corrosion Science
Corrosion of water pipe systems due to acidification of soil and groundwater, 18:26720 (R;SE)

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Stirling cycle heat pumps and refrigerators, 18:26517 (R;SE)

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Partial gasification PFBC, Stage 2. Final report, 18:25543 (R;SE;In Swedish)

Royal Inst. of Tech., Stockholm (Sweden). Dept. of Water Resources Engineering
Corrosion of cast-iron in soil, 18:26722 (R;SE)
Corrosion of underground water pipes due to acidification of soil and groundwater, 18:26712 (R;SE)
Corrosion of underground water pipes due to acidification by air pollution - Damage frequency analysis, 18:26721 (R;SE)

Rutherford Appleton Lab., Chilton (United Kingdom)
Implications for minimal supersymmetry from grand unification and the neutralino relic abundance, 18:27761 (R;GB)
ISIS annual report for the financial year 1 April 1991 to 31 March 1992. V. 1, 18:28084 (R;GB)
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New data on the KK-bar threshold region and the nature of the $f_0(S^*)$, 18:27808 (R;GB)
On the validity of perturbative evolution of structure functions from low Q^2, 18:27760 (R;GB)
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Scalar mesons in ϕ radiative decay: Their implications for spectroscopy and for studies of CP-violation at ϕ factories, 18:27798 (R;GB)
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The impact of climate variability on the UK wind resource. Final report, 18:26060 (R;GB)
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A multiphase model for shock-induced flow in low density foam, 18:26817 (R;US)
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A perspective on AVS in an engineering sciences environment, 18:28188 (R;US)
A rationale for studying severe accidents, 18:26375 (RA;US)
A simplified model of aerosol removal by containment sprays, 18:26363 (R;US)
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An efficient parallel algorithm for matrix-vector multiplication, 18:28185 (R;US)
Application of EM holographic methods to borehole vertical electric source data to map a fuel oil spill, 18:25606 (R;US)
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Center of trace algorithms for extracting digitized waveforms from two-dimensional images, 18:26908 (R;US)
Characteristics of HEM silicon produced in a reusable crucible, 18:26813 (R;US)
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Cross borehole electromagnetic imaging of chemical and mixed waste landfills, 18:25877 (R;US)
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Direct drilling related releases from the WIPP repository, 18:25757 (R;US)
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Fire accident analysis modeling in support of non-reactor nuclear facilities at Sandia National Laboratories, 18:25878 (R;US)
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Hydrogen distribution and combustion, 18:26379 (RA;US)
In-vessel melt progression in the HW-NPR, 18:26376 (RA;US)
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Integrated Risk Assessment for the LaSalle Unit 2 Nuclear Power Plant: Phenomenology and Risk Uncertainty Evaluation Program (PRUEP): Appendices A–C: Volume 2, Part 1, 18:26360 (R;US)
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ITS Version 3.0: The Integrated TIGER Series of coupled electron/photon Monte Carlo transport codes, 18:27878 (R;US)
JAC3D – A three-dimensional finite element computer program for the nonlinear quasi-static response of solids with the conjugate gradient method: Yucca Mountain Site Characterization Project, 18:25752 (R;US)

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Variance reduction unique to coupled electron/photon Monte Carlo transport, 18:27877 (R;US)
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[Travel to Guatemala to discuss plans to incorporate renewable energy technologies into rural electrification programs]: Foreign trip report, September 16, 1992–October 7, 1992, 18:26003 (R;US)
[Travel to New Zealand for studies in electromagnetic inversion applied to the earth and its relevance to environmental remediation]: Foreign trip report, August 23–September 12, 1992, 18:27664 (R;US)
[Travel to Russia and the UK concerning mining and heat extraction technology]: Foreign trip report, September 11–24, 1992, 18:26039 (R;US)
[Travel to the UK concerning semiconductor research]: Foreign trip report, 16 July–4 August 1992, 18:26789 (R;US)

Sandia National Labs., Livermore, CA (United States)
A trip to Hungary to present a paper on bioremediation and to attend the international symposium on environmental contamination in central and eastern Europe: Foreign trip report, October 10–October 19, 1992, 18:26439 (R;US)
Process Waste Assessment, Mechanics Shop, 18:26538 (R;US)
[Travel to France to the IAEA technical committee meeting on atomic and molecular data for fusion reactor technology]: Foreign trip report, October 9–18, 1992, 18:28036 (R;US)

Savoie Univ., 73 - Chambery (France)
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Science Applications International Corp., Idaho Falls, ID (United States)
Technical and regulatory review of the Rover nuclear fuel process for use on Fort St. Vrain fuel, 18:25705 (R;US)

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Science Applications International Corp., McLean, VA (United States)
The economics of proliferation and counterproliferation: Final report, 18:26564 (R;US)
[A meeting in Belgium on solar retrofitting]: Foreign trip report, August 31–September 2, 1992, 18:26009 (R;US)

Scientific and Applied Research Center (SARC), Doha (Qatar)
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Secretariat d'Etat a la Recherche, Algiers (Algeria)
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Self (William) Associates, Orinda, CA (United States)
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Senior Thermal Engineering Ltd., Wakefield (United Kingdom)
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Service Central de Protection contre les Rayonnements Ionisants, 78 - Le Vesinet (France)
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Assessment of RELAP5/MOD3/V5M5 against the UPTF Test No. 11 (countercurrent flow in PWR hot leg), 18:26160 (R;US)

Skidaway Inst. of Oceanography, Savannah, GA (United States)
Biological processes in the water column of the South Atlantic Bight: Phytoplankton response: Final progress report, 18:27478 (R;US)

South Carolina Univ., Columbia, SC (United States)
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[Workshop for coordinating South Carolina's pre-college systemic initiatives in science and mathematics], 18:28072 (R;US)

South Carolina Wildlife and Marine Resources Dept., Columbia, SC (United States)
Wildlife management assistance report: Progress report, July 1, 1991–June 30, 1992, 18:27399 (R;US)

Southern Co. Services, Inc., Birmingham, AL (United States)
Run 263 with Black Thunder Mine subbituminous coal and dispersed molybdenum catalysts: Technical progress report, 18:25533 (R;US)

Southern Electric International, Inc., Wilsonville, AL (United States)
Run 263 with Black Thunder Mine subbituminous coal and dispersed molybdenum catalysts: Technical progress report, 18:25533 (R;US)

Southern States Energy Board, Norcross, GA (United States)
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Stanford Linear Accelerator Center, Menlo Park, CA (United States)
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AC02-80ER10667	**Pittsburgh Univ., PA (United States). Dept. of Physics and Astronomy**	
	18:27174	CONF-9209263–13
AC02-83CH10093	**National Renewable Energy Lab., Golden, CO (United States)**	
	18:25994	NREL/TP–411-5013
	18:26002	DOE/CH/10093–190
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	18:26025	NREL/TP–471-5536
	18:26088	NREL/TP–441-5611
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	18:26499	DOE/CH/10093–187
	18:26544	DOE/FTR–93011812
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AC02-83CH10140	**Battelle, Columbus, OH (United States)**	
	18:28154	ESTSC–000588C017600
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AC03-76SF00098	**USDOE Morgantown Energy Technology Center, WV (United States)**	
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	Lawrence Berkeley Lab., CA (United States)	
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	Lawrence Livermore National Lab., CA (United States)	
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AC03-76SF00515	**Stanford Linear Accelerator Center, Menlo Park, CA (United States)**	
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	18:27799	SLAC-PUB–5832
	18:27912	SLAC–417
	18:28190	SLAC-PUB–5967
AC03-89ER51114	**General Atomics, San Diego, CA (United States)**	
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AC03-89ER53277	**General Atomics, San Diego, CA (United States)**	
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	18:26128	DOE/SF/19682–T1-Vol.2
AC04-76DP00613	**Allied-Signal, Inc., Kansas City, MO (United States). Bendix Kansas City Div.**	
	18:27064	KCP–613-5221
	Allied-Signal Aerospace Co., Kansas City, MO (United States). Kansas City Div.	
	18:25720	KCP–613-5137
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	18:26944	KCP–613-5078
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AC04-76DP00789	**Sandia National Labs., Albuquerque, NM (United States)**	
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AC04-76DR00789	**Sandia National Labs., Livermore, CA (United States)**	
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AC04-86AL31950	**Westinghouse Electric Corp., Carlsbad, NM (United States). Waste Isolation Div.**	
	18:25699	DOE/WIPP–92-007
	18:25700	DOE/WIPP–93-012
AC04-88DP43495	**Mound, Miamisburg, OH (United States)**	
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AC04-91AL65030	**Mason and Hanger-Silas Mason Co., Inc., Amarillo, TX (United States)**	
	18:25730	MHSMP–92-41
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AC05-76OR00001	**Oak Ridge K-25 Site, TN (United States)**	
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AC05-84OR21400	**Oak Ridge National Lab., TN (United States)**	
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	18:25738	ORNL/TM–12058
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	18:26275	ORNL/FTR–4118
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	18:25695	DOE/OR--01-1100-D2
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	18:25874	PNL-SA--21987
	Lawrence Livermore National Lab., CA (United States)	
	18:26729	UCRL-JC--110687
	Nuclear Regulatory Commission, Washington, DC (United States). Div. of Engineering	
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	Martin Marietta Energy Systems, Inc., Oak Ridge, TN (United States)	
	18:27387	CONF-930483--10
	Joint Inst. for Heavy Ion Research, Oak Ridge, TN (United States)	
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	National Inst. of Standards and Technology, Gaithersburg, MD (United States)	
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	USDOE Office of Administration and Management, Washington, DC (United States)	
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	18:27303	CONF-9110336--
AC05-84OS21400	**Oak Ridge Y-12 Plant, TN (United States)**	
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AC05-84OT21400	**Oak Ridge K-25 Site, TN (United States)**	
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	18:27894	K/ETO--127
AC05-86OR21548	**USDOE Oak Ridge Field Office, TN (United States). Weldon Spring Site Remedial Action Project**	
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AC06-76RL01830	**Douglas United Nuclear, Inc., Richland, WA (United States)**	
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	Hanford Works, Richland, WA (United States)	
	18:25639	HW--18712
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	General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation	
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	18:27434	NUREG/CR–5996
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	D and R International Ltd., Silver Spring, MD (United States)	
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AC06-80ER53098	**STI Optronics, Bellevue, WA (United States)**	
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AC06-87RL10930	**Westinghouse Hanford Co., Richland, WA (United States)**	
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AC07-76ID01570	**EG and G Idaho, Inc., Idaho Falls, ID (United States)**	
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AC07-84ID12435	**Westinghouse Idaho Nuclear Co., Inc., Idaho Falls, ID (United States)**	
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AC07-85ID12578	**Institute of Gas Technology, Chicago, IL (United States)**	
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	Eaton Operating Co., Inc., Houston, TX (United States)	
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AC08-87NV10576	**Science Applications International Corp., Las Vegas, NV (United States)**	
	18:25682	CONF-920866–7
AC08-88NV10617	**Los Alamos National Lab., NM (United States)**	
	18:27073	LA-UR–93-1833
	EG and G Energy Measurements, Inc., Goleta, CA (United States). Santa Barbara Operations	
	18:26792	EGG–10617-2186
	18:27180	EGG–10617-2168
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	EG and G Energy Measurements, Inc., Las Vegas, NV (United States). Remote Sensing Lab.	
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AC08-90NV10845	**Nevada Univ., Reno, NV (United States). Water Resources Center**	
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AC08-93NV11265	**Lawrence Livermore National Lab., CA (United States)**	
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AC09-76SR00001	**Academy of Natural Sciences of Philadelphia, PA (United States). Dept. of Limnology**	
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	18:25908	SR/H–573
	18:26264	SR/H–546
	18:26282	DPSP–53-1-3-Del.Ver.
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	18:25835	WSRC-TR–93-233
	18:25884	WSRC-MS–92-477-Rev.1
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	18:26392	WSRC-TR–91-372-Rev.2
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AC12-76SN00052	Knolls Atomic Power Lab., Schenectady, NY (United States)	
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AC21-87MC24267	North Dakota Univ., Grand Forks, ND (United States). Energy and Environmental Research Center	
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AC21-88MC25135	Aluminum Co. of America, Alcoa Center, PA (United States). Alcoa Technical Center	
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AC21-89MC26302	Viscoustech, Allison Park, PA (United States)	
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AC21-90MC27168	Energy Research Corp., Danbury, CT (United States)	
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AC21-90MC27227	USDOE Morgantown Energy Technology Center, WV (United States)	
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AC21-91MC27240	USDOE Morgantown Energy Technology Center, WV (United States)	
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AC21-91MC27259	USDOE Morgantown Energy Technology Center, WV (United States)	
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AC22-86PC90258	Energy International, Inc., Pittsburgh, PA (United States)	
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AC22-86PC90751	USDOE Pittsburgh Energy Technology Center, PA (United States)	
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AC22-86PC91257	TRW Space and Technology Group, Redondo Beach, CA (United States). Applied Technology Div.	
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AC22-87PC79890	CoaLiquid, Inc., Louisville, KY (United States)	
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AC22-87PC79936	SRI International, Menlo Park, CA (United States)	
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AC22-88PC79815	Michigan Biotechnology Inst., Lansing, MI (United States)	
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AC22-88PC88811	Chicago Univ., IL (United States). Dept. of Chemistry	
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AC22-89BC14475	California Univ., Berkeley, CA (United States)	
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AC22-89PC89876	Arkansas Univ., Fayetteville, AR (United States). Dept. of Chemical Engineering	
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AC22-90PC89865	Air Products and Chemicals, Inc., Allentown, PA (United States)	
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AC22-90PC90033	Southern Co. Services, Inc., Birmingham, AL (United States)	
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AC22-91PC91054	**Pittsburgh Univ., PA (United States). Dept. of Chemical and Petroleum Engineering**	
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AC22-92BC14831	**Louisiana State Univ., Baton Rouge, LA (United States). Dept. of Petroleum Engineering**	
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AC34-90DP62349	**EG and G Rocky Flats, Inc., Golden, CO (United States)**	
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AC35-89ER40486	**Houston Univ., TX (United States). Dept. of Physics**	
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AI01-88NE32140	**Johns Hopkins Univ., Laurel, MD (United States). Applied Physics Lab.**	
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AI05-83ER40112	**Lawrence Livermore National Lab., CA (United States)**	
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AI05-88ER60665	**Geological Survey, Denver, CO (United States)**	
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AI05-88OR21822	**JAYCOR, Vienna, VA (United States)**	
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AI05-92ER54177	**Lawrence Livermore National Lab., CA (United States)**	
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AI09-85SR14069	**USDOE Savannah River Operations Office, Aiken, SC (United States)**	
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AS05-80ER10713	Virginia Polytechnic Inst. and State Univ., Blacksburg, VA (United States). Dept. of Physics	
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BI79-88BP92818	Oregon State Univ., Corvallis, OR (United States). Dept. of Fisheries and Wildlife	
	18:25988	DOE/BP/92818-1
BI79-91BP21065	Idaho Dept. of Fish and Game, Eagle, ID (United States)	
	18:25982	DOE/BP/21065-1
BI79-91BP60629	Washington Dept. of Fisheries, Olympia, WA (United States)	
	18:25986	DOE/BP/60629-3
	USDOE Bonneville Power Administration, Portland, OR (United States). Div. of Fish and Wildlife	
	18:25984	DOE/BP/60629-1
	Idaho Dept. of Fish and Game, Boise, ID (United States)	
	18:25987	DOE/BP/60629-5
	Oregon Dept. of Fish and Wildlife, Portland, OR (United States)	
	18:25985	DOE/BP/60629-2
FC01-87CH10324	Southern States Energy Board, Norcross, GA (United States)	
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	18:25655	DOE/CH/10324-T2
	18:25656	DOE/CH/10324-T3
	18:25657	DOE/CH/10324-T5
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	18:25852	DOE/CH/10324-T9
	18:25853	DOE/CH/10324-T13
	18:25854	DOE/CH/10324-T17
	18:25899	DOE/CH/10324-T4
	18:27658	DOE/CH/10324-T19
FC02-90CE40903	Membrane Technology and Research, Inc., Menlo Park, CA (United States)	
	18:25951	DOE/CE/40903-2
FC04-82AL16257	USDOE Albuquerque Field Office, NM (United States). Uranium Mill Tailings Remedial Action Project Office	
	18:25862	DOE/UMTRA-050506-Vol.3-App.F
FC07-85NV10412	Texas Univ., Austin, TX (United States). Center for Petroleum and Geosystems Engineering	
	18:26044	DOE/NV/10412-5
FC07-90ID12945	University of Southwestern Louisiana, Lafayette, LA (United States). Acadiana Research Lab.	
	18:26051	DOE/ID/12945-T10
FC08-90NV10872	Nevada Univ., Las Vegas, NV (United States). Dept. of Civil and Environmental Engineering	
	18:25694	DOE/NV/10872-T57
FC21-92MC28065	M-C Power Corp., Burr Ridge, IL (United States)	
	18:26481	DOE/MC/28065-3371
FC22-83FE60149	National Inst. for Petroleum and Energy Research, Bartlesville, OK (United States)	
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FC22-87PC79799	USDOE Pittsburgh Energy Technology Center, PA (United States)	
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FG01-89CE15425	Northern Light R&D, Seattle, WA (United States)	
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FG01-90CE15495	Hopenfeld (Joram), Rockville, MD (United States)	
	18:26896	DOE/CE/15495-T6
FG01-91CE15474	North Dakota State Univ., Langdon, ND (United States). Langdon Research Center	
	18:27540	DOE/CE/15474-T3
FG01-92CE15974	Nebraska Univ., Lincoln, NE (United States). Dept. of Electrical Engineering	
	18:25996	DOE/CE/15974-T4
FG02-84ER13183	Wisconsin Univ., Madison, WI (United States)	
	18:26858	DOE/ER/13183-8
FG02-84ER45141	Minnesota Univ., Minneapolis, MN (United States). Dept. of Chemical Engineering and Materials Science	
	18:26601	DOE/ER/45141-9
FG02-84ER60253	Kansas State Univ., Manhattan, KS (United States). Dept. of Agronomy	
	18:27389	DOE/ER/60253-9
FG02-85ER13359	Yale Univ., New Haven, CT (United States)	
	18:25952	DOE/ER/13359-9
FG02-86ER13560	United Technologies Research Center, East Hartford, CT (United States)	
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FG02-86ER13616	Indiana Univ., Bloomington, IN (United States)	
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FG02-86ER25015	Massachusetts Univ., Amherst, MA (United States)	
	18:28138	DOE/ER/25015-T1
FG02-86ER45237	State Univ. of New York, Stony Brook, NY (United States). Dept. of Chemistry	
	18:26785	DOE/ER/45237-7
FG02-86ER60405	New York Univ., NY (United States). Radiation and Solid State Lab.	
	18:27647	DOE/ER/60405-8
FG02-86SF16306	Colorado State Univ., Fort Collins, CO (United States). Solar Energy Applications Lab.	
	18:26010	DOE/SF/16306-36
	Colorado State Univ., Fort Collins, CO (United States). Dept. of Agricultural and Chemical Engineering	
	18:26857	CONF-930364-4
FG02-87ER13740	Stevens Inst. of Tech., Hoboken, NJ (United States). Dept. of Physics and Engineering Physics	
	18:27914	DOE/ER/13740-11
FG02-87ER13749	Ohio State Univ. Research Foundation, Columbus, OH (United States). Dept. of Welding Engineering	
	18:27662	DOE/ER/13749-4
FG02-87ER45283	Brookhaven National Lab., Upton, NY (United States)	
	18:27907	BNL-48361

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FG02-87ER45298	Cornell Univ., Ithaca, NY (United States). Dept. of Chemistry	
	18:26786	DOE/ER/45298–9
FG02-87ER45315	Michigan Technological Univ., Houghton, MI (United States)	
	18:26602	DOE/ER/45315–17
FG02-87ER45334	Ohio Univ., Athens, OH (United States)	
	18:27898	DOE/ER/45334–6
FG02-87ER60502	Vermont Univ., Burlington, VT (United States)	
	18:27606	DOE/ER/60502–7
FG02-87ER60547	New York Univ., NY (United States). School of Medicine	
	18:27605	CONF-910905–5
FG02-88ER13896	Massachusetts Inst. of Tech., Cambridge, MA (United States). Dept. of Chemical Engineering	
	18:26920	CONF-9209344–1
FG02-88ER13933	Pittsburgh Univ., PA (United States). Dept. of Chemistry	
	18:26859	DOE/ER/13933–3
FG02-88ER13934	Cornell Univ., Ithaca, NY (United States). Dept. of Chemistry	
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FG02-88ER13960	Pittsburgh Univ., PA (United States)	
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FG02-88ER40388	State Univ. of New York, Stony Brook, NY (United States). Dept. of Physics	
	18:27747	DOE/ER/40388–102
FG02-88ER45362	Rensselaer Polytechnic Inst., Troy, NY (United States)	
	18:26787	DOE/ER/45362–3
FG02-88ER60631	Columbia Univ., New York, NY (United States). Center for Radiological Research	
	18:27607	DOE/ER/60631–11
	18:27608	DOE/ER/60631–12
FG02-88ER60633	Wisconsin Univ., Madison, WI (United States)	
	18:27390	DOE/ER/60633–8
FG02-89ER14079	Colorado School of Mines, Golden, CO (United States)	
	18:27663	DOE/ER/14079–24
FG02-89ER45391	Minnesota Univ., Minneapolis, MN (United States). Dept. of Chemical Engineering and Materials Science	
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FG02-89ER53297	Columbia Univ., New York, NY (United States)	
	18:27949	DOE/ER/53297–5
FG02-90ER14119	Rochester Univ., NY (United States). Dept. of Physics and Astronomy	
	18:27881	CONF-9101167–1
FG02-90ER14128	Cornell Univ., Ithaca, NY (United States)	
	18:26887	DOE/ER/14128–T1
FG02-90ER40560	Chicago Univ., IL (United States)	
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	18:27748	DOE/ER/40560–4C
	18:27772	DOE/ER/40560–4B
FG02-90ER45438	Pittsburgh Univ., PA (United States)	
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FG02-90ER54092	Illinois Univ., Urbana, IL (United States)	
	18:28032	CONF-921103–13-App.C
	Illinois Univ., Urbana, IL (United States). Fusion Studies Lab.	
	18:27942	CONF-921103–11-App.B
	18:27943	CONF-921103–12-App.A
	18:27944	CONF-930281–7
FG02-90ER60970	Colorado State Univ., Fort Collins, CO (United States). Dept. of Atmospheric Science	
	18:27316	DOE/ER/60970–T1
FG02-90ER50972	Ohio State Univ. Research Foundation, Columbus, OH (United States)	
	18:27522	DOE/ER/60972–3
FG02-90ER60980	Woods Hole Oceanographic Institution, MA (United States)	
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FG02-90ER60984	Michigan Univ., Ann Arbor, MI (United States)	
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FG02-90ER61013	Syracuse Univ., NY (United States). Dept. of Geology	
	18:27480	DOE/ER/61013–T2
FG02-90ER61014	New York Univ., NY (United States). Dept. of Applied Science	
	18:27318	DOE/ER/61014–3
FG02-90ER61033	Boston Univ., MA (United States). Dept. of Chemistry	
	18:26775	CONF-9209253–5
FG02-90ER80896	USDOE Morgantown Energy Technology Center, WV (United States)	
	18:25498	DOE/METC–92/6128-Vol.1
FG02-91ER14193	Utah Univ., Salt Lake City, UT (United States). Dept. of Chemistry	
	18:26860	DOE/ER/14193–5
FG02-91ER14205	Cornell Univ., Ithaca, NY (United States). Dept. of Physics	
	18:26876	DOE/ER/14205–2
FG02-91ER14225	Columbia Univ., New York, NY (United States)	
	18:27888	DOE/ER/14225–2
FG02-91ER20037	Cornell Univ., Ithaca, NY (United States)	
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FG02-91ER20041	Ohio State Univ., Columbus, OH (United States). Dept. of Microbiology	
	18:27516	DOE/ER/20041–1
FG02-91ER40646	Pittsburgh Univ., PA (United States). Dept. of Physics and Astronomy	
	18:27174	CONF-9209263–13
FG02-91ER40648	Massachusetts Inst. of Tech., Cambridge, MA (United States). Plasma Fusion Center	
	18:26964	DOE/ER/40648–2
FG02-91ER45461	Pennsylvania State Univ., University Park, PA (United States)	
	18:26500	DOE/ER/45461–12
	18:26606	DOE/ER/45461–22
	Pennsylvania State Univ., University Park, PA (United States). Center for Advanced Materials	
	18:26225	DOE/ER/45461–11
	18:26226	DOE/ER/45461–20
	18:26227	DOE/ER/45461–21
	18:26603	DOE/ER/45461–2
	18:26604	DOE/ER/45461–9
	18:26605	DOE/ER/45461–10
FG02-91ER54109	General Atomics, San Diego, CA (United States)	
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FG02-91ER54110	Massachusetts Inst. of Tech., Cambridge, MA (United States)	
	18:28037	DOE/FTR–93014983
	Massachusetts Inst. of Tech., Cambridge, MA (United States). Plasma Fusion Center	
	18:27935	DOE/FTR–93011660
FG02-91ER54131	College of Staten Island, NY (United States)	
	18:27950	DOE/ER/54131–2
FG02-91ER61228	Massachusetts General Hospital, Boston, MA (United States). Wellman Labs. of Photomedicine	
	18:27648	DOE/ER/61228–T1

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FG02-91ER75636	Exploratorium, San Francisco, CA (United States)	
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FG02-92ER14273	Delaware Univ., Newark, DE (United States). Dept. of Chemistry and Biochemistry	
	18:26861	DOE/ER/14273–1
FG02-92ER14275	Princeton Univ., NJ (United States)	
	18:26784	DOE/ER/14275–1
FG02-92ER14306	Wisconsin Univ., Madison, WI (United States). Dept. of Chemistry	
	18:26888	DOE/ER/14306–1
FG02-92ER20076	Ohio State Univ., Columbus, OH (United States)	
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FG02-92ER25133	Illinois Univ., Chicago, IL (United States)	
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FG02-92ER40699	Columbia Univ., New York, NY (United States)	
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FG02-92ER40747	Indiana Univ., Bloomington, IN (United States). Dept. of Physics	
	18:26997	DOE/ER/40747–2
FG02-92ER61474	Wisconsin Univ., Madison, WI (United States)	
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FG02-92ER75730	Network, Inc., Andover, MA (United States)	
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FG02-92ER75760	New York Hall of Science, NY (United States)	
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FG02-92ER75773	Michigan Technological Univ., Houghton, MI (United States)	
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FG02-92ER81360	Boston Univ., MA (United States). Dept. of Chemistry	
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FG02-93ER12128	State Univ. of New York, Alfred, NY (United States). Coll. of Ceramics	
	18:26749	DOE/ER/12128–1
FG02-93ER40768	State Univ. of New York, Stony Brook, NY (United States). Dept. of Physics	
	18:27828	DOE/ER/40768–1
FG03-85ER13419	California Univ., Berkeley, CA (United States). Dept. of Geology and Geophysics	
	18:26050	DOE/ER/13419–T2
FG03-86ER45249	California Univ., Davis, CA (United States). Dept. of Mechanical, Aeronautical and Materials Engineering	
	18:26750	DOE/ER/45249–T2
FG03-89ER51121	General Atomics, San Diego, CA (United States)	
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	18:27993	GA-A–21304
FG03-89ER60759	Stanford Univ., CA (United States)	
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FG03-92ER25117	Stanford Univ., CA (United States). Systems Optimization Lab.	
	18:28191	SOL–93-3
FG03-92ER40711	Lawrence Livermore National Lab., CA (United States)	
	18:27215	UCRL-JC–111941
FG03-93ER40757	Texas Univ., Austin, TX (United States). Center for Particle Physics	
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FG03-93ER40765	Texas A and M Univ., College Station, TX (United States)	
	18:27773	DOE/ER/40765–T1
FG05-84ER40149	Florida Univ., Alachua, FL (United States). Inst. for Astrophysics and Planetary Exploration	
	18:27178	DOE/ER/40149–T1
FG05-87ER13745	Georgia Inst. of Tech., Atlanta, GA (United States). School of Physics	
	18:27887	DOE/ER/13745–3
FG05-87ER40330	Oak Ridge National Lab., TN (United States)	
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FG05-87ER40361	Joint Inst. for Heavy Ion Research, Oak Ridge, TN (United States)	
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	18:27816	CONF-9303189–1
FG05-87ER40374	Houston Univ., TX (United States)	
	18:26996	DOE/ER/40374–72
	Houston Univ., TX (United States). Dept. of Physics	
	18:28140	DOE/ER/40374–70
FG05-88ER40407	Vanderbilt Univ., Nashville, TN (United States). Dept. of Physics	
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FG05-88ER53267	Oak Ridge National Lab., TN (United States)	
	18:27947	CONF-930720–11
FG05-88ER60721	Rice Univ., Houston, TX (United States). Dept. of Physics	
	18:27909	DOE/ER/60721–6
FG05-89ER14090	Maryland Univ., Baltimore, MD (United States). Dept. of Electrical Engineering	
	18:27218	DOE/ER/14090–4
FG05-90ER20005	Tennessee Univ., Knoxville, TN (United States)	
	18:25942	CONF-9005443–
FG05-90ER45431	Georgia Inst. of Tech., Atlanta, GA (United States). School of Physics	
	18:26752	DOE/ER/45431–3
FG05-90ER61056	National Academy of Sciences - National Research Council, Washington, DC (United States)	
	18:27319	DOE/ER/61056–T1
FG05-90ER80877	USDOE Morgantown Energy Technology Center, WV (United States)	
	18:26100	DOE/METC–92/6128-Vol.1
FG05-92ER75842	South Carolina Univ., Columbia, SC (United States)	
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FG05-93ER40770	Joint Inst. for Heavy Ion Research, Oak Ridge, TN (United States)	
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FG06-85ER40224	Oregon Univ., Eugene, OR (United States)	
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FG06-88ER40427	Washington Univ., Seattle, WA (United States). Dept. of Physics	
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	Los Alamos National Lab., NM (United States)	
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FG06-89ER75522	Pacific Northwest Lab., Richland, WA (United States)	
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	18:26873	PNL–SA-22038
FG06-90ER40561	Los Alamos National Lab., NM (United States)	
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FG06-90ER45415	Washington Univ., Seattle, WA (United States). Dept. of Physics	
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	18:27883	DOE/ER/45415–6

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FG06-90ER61034	Washington Univ., Seattle, WA (United States). Dept. of Applied Mathematics	
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FG06-91ER40637	Oregon Univ., Eugene, OR (United States)	
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FG06-92ER61422	Oregon State Univ., Corvallis, OR (United States)	
	18:27481	DOE/ER/61422–1
FG06-92ER61423	Oregon State Univ., Corvallis, OR (United States). Coll. of Oceanography	
	18:27482	DOE/ER/61423–1
FG06-92RL12523	Eastern Oregon State Coll., La Grande, OR (United States)	
	18:28073	DOE/RL/12523–1
FG07-89ID12842	Louisiana State Univ., Baton Rouge, LA (United States)	
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FG07-90ID13025	Maryland Univ., College Park, MD (United States)	
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FG07-91ID13042	Geological Survey, Denver, CO (United States)	
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	Idaho INEL Oversight Program, Boise, ID (United States)	
	18:27392	DOE/ID/13042–5
	18:27393	DOE/ID/13042–7
	Boise State Univ., ID (United States). Dept. of Geosciences	
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FG08-90ER61012	Nevada Univ., Reno, NV (United States). Desert Research Inst.	
	18:27317	DOE/ER/61012–T3
FG09-84ER40160	Georgia Univ., Athens, GA (United States). Dept. of Physics and Astronomy	
	18:27771	DOE/ER/40160–9
FG09-85ER60353	Skidaway Inst. of Oceanography, Savannah, GA (United States)	
	18:27478	DOE/ER/60353–T1
FG09-87ER13709	Georgia Univ., Athens, GA (United States). Dept. of Botany	
	18:27515	DOE/ER/13709–5
FG09-87SR15191	South Carolina Wildlife and Marine Resources Dept., Columbia, SC (United States)	
	18:27399	DOE/SR/15191–5
FG09-90ER61040	South Carolina Univ., Columbia, SC (United States)	
	18:27517	DOE/ER/61040–2
FG09-91SR18217	Medical Univ. of South Carolina, Charleston, SC (United States). Dept. of Biostatistics, Epidemiology, and System Sciences	
	18:25922	DOE/SR/18217–2
FG21-90MC27351	Lehigh Univ., Bethlehem, PA (United States)	
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	18:25612	DOE/MC/27351–3336
FG22-85PC80906	SRI International, Menlo Park, CA (United States)	
	18:25478	CONF-890902–30
FG22-86PC90537	Utah Univ., Salt Lake City, UT (United States). Dept. of Fuels Engineering	
	18:25537	DOE/PC/90537–T1
FG22-88BC14205	Alpha Environmental Corp., Austin, TX (United States)	
	18:25585	DOE/BC/14205–17
FG22-88PC88933	Lehigh Univ., Bethlehem, PA (United States)	
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FG22-89BC14425	Alabama Geological Survey, Tuscaloosa, AL (United States)	
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	18:25581	DOE/BC/14425–T13-App.1-Vol.3
	18:25582	DOE/BC/14425–T13-App.I-Vol.2
	18:25586	DOE/BC/14425–T12
FG22-89PC89767	Yale Univ., New Haven, CT (United States). Dept. of Chemical Engineering	
	18:25529	DOE/PC/89767–T11
FG22-89PC89776	Northeastern Univ., Boston, MA (United States). Dept. of Mechanical Engineering	
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FG22-90PC90307	Brown Univ., Providence, RI (United States). Div. of Engineering	
	18:25534	DOE/PC/90307–7
	18:25535	DOE/PC/90307–8
FG22-90PC90309	Tennessee Univ., Tullahoma, TN (United States). Space Inst.	
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FG22-90PC90312	Hampton Univ., VA (United States). Dept. of Engineering	
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FG22-91PC91283	Tuskegee Univ., AL (United States). Dept. of Chemical Engineering	
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FG22-91PC91305	Brown Univ., Providence, RI (United States). Div. of Engineering	
	18:26791	DOE/PC/91305–6
FG22-92PC92152	Carnegie-Mellon Univ., Pittsburgh, PA (United States). Dept. of Mechanical Engineering	
	18:25574	DOE/PC/92152–T3
FG22-92PC92535	Northeastern Univ., Boston, MA (United States). Dept. of Mechanical Engineering	
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FG79-89BP94402	Columbia River Inter-Tribal Fish Commission, Portland, OR (United States)	
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W-31109-ENG-38	Argonne National Lab., IL (United States)	
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	18:25995	ANL/CHM/CP–79459
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92/17	18:26221	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93010996	PC-940; PC-1000
92/6	18:26337	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012143	PC-940; PC-1030
92/7	18:26338	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93013052	PC-940
93/3	18:26340	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93010894	PC-940
93/6	18:26341	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012377	PC-1000; PC-940
ANL/PHY/CP–					
79497	18:27830	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015144	MF-413
79517	18:27037	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012902	MF-413
79637	18:27880	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015158	MF-411
ANL/RE–					
93/4	18:25849	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015437	MF-506
ANL/XFD/CP–					
78973	18:26892	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015545	MF-411
79506	18:27701	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012905	MF-404; MF-406
79634	18:26569	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015162	MF-404
ARL-TR–					
086	18:27383	OSTI; NTIS (US Sales Only); INIS		DE93630629	
AUC-IBT-R–					
9313	18:26066	OSTI; NTIS		DE93500150	
9315	18:26067	OSTI; NTIS		DE93500098	
BARC–					
1992/E/030	18:26773	OSTI; NTIS (US Sales Only); INIS		DE93630597	
1992/E/038	18:26224	OSTI; NTIS (US Sales Only); INIS		DE93631484	
BMI–					
2173-Vol.2-No.2	18:26240	*See* NUREG/CR–4599-Vol.2-No.2			
BN-SA–					
3768-HEDR	18:27603	OSTI; NTIS; INIS		DE93012871	
BNL–					
47596	18:27038	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014322	MF-414
48208	18:27039	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014289	MF-414
48217	18:27153	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015404	MF-414
48218	18:27886	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014306	MF-414

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Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
48220	18:26963	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015405	MF-414
48233	18:26982	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014288	MF-414
48235	18:26983	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014312	MF-414
48236	18:27040	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014297	MF-414
48237	18:26984	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014334	MF-414
48239	18:26985	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014296	MF-414
48240	18:26986	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015407	MF-414
48260	18:27041	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014314	MF-414
48271	18:27154	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015403	MF-414
48272	18:27042	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015786	MF-414
48361	18:27907	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016218	MF-406
48367	18:27155	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015398	MF-411
48373	18:26987	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015400	MF-414
48374	18:26988	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014284	MF-414
48375	18:26989	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014329	MF-414
48386	18:26990	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015401	MF-414
48388	18:26991	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014328	MF-414
48476	18:27474	OSTI; NTIS; GPO Dep.	E 1.99:	DE93009351	MF-403
48499	18:27271	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93009347	MF-600
48540	18:26202	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013148	MF-528
48561	18:27521	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93010867	MF-408
48562	18:26203	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93010936	MF-743
48580	18:26835	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93010880	MF-902; MF-906
48642	18:28030	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015399	MF-414
48655	18:26570	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014056	MF-404
48665	18:26571	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014023	MF-404
48667	18:26204	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93014336	MF-743
48694	18:27831	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014045	MF-414
48697	18:26342	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012523	MF-520
48698	18:26205	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93014046	MF-743
48700	18:26206	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012524	MF-743
48706	18:26572	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014054	MF-404
48707	18:26573	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014055	MF-404
48717	18:27766	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012522	MF-413
48755	18:27272	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013149	
48807	18:27170	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014316	MF-406
48820	18:26279	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015198	MF-404
48832	18:27767	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014319	MF-414
48865	18:27801	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014320	MF-413
48871	18:27768	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014321	MF-414
48876	18:27769	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014290	MF-413
48879	18:27811	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014323	MF-413
48880	18:27832	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013143	MF-413
48886	18:27812	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014324	MF-413
48887	18:26836	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014325	MF-404
48888	18:27833	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014292	MF-413
48894	18:26992	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014301	MF-414
48895	18:27908	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014291	MF-414
48897	18:26919	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014293	MF-406
48922	18:27745	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015759	MF-414
48923	18:26884	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015758	MF-401
48953	18:26574	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014326	MF-406
48954	18:26575	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014327	MF-411
48958	18:26993	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015787	MF-414
48960	18:27171	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014335	MF-404
48966	18:26856	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015393	MF-411
48968	18:28094	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014285	MF-515
48991	18:25681	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014287	MF-402
49036	18:26893	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016736	MF-706
49073	18:27043	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015793	MF-414
52372	18:25850	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013930	PC-406; PC-403
70039	18:27273	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011246	MF-402
70157	18:27274	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011059	MF-402
70173	18:27834	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93013815	MF-414
70222	18:27384	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012357	MF-402
70276	18:27275	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93008862	MF-902
BNL-NUREG–					
47879	18:26343	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013342	
48522	18:26250	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015796	

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
48657	18:26344	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012525	
48658	18:26251	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014004	
48890	18:26345	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014302	
48969	18:26117	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015395	
52346	18:25732	*See* NUREG/CR–5943			
52355	18:26364	*See* NUREG/CR–5983			
52375	18:27435	*See* NUREG/CR–6041			
BS–					
295	18:26507	*See* LBL–33075			
CAP–					
95-ATF-93C	18:26993	*See* BNL–48958			
CBL–					
40	18:26934	OSTI; NTIS		DE93500154	
41	18:26894	OSTI; NTIS		DE93500157	
CEA-CONF–					
11288	18:26125	OSTI; NTIS (US Sales Only); INIS		DE93628301	
11290	18:26576	OSTI; NTIS (US Sales Only); INIS		DE93630437	
11291	18:26577	OSTI; NTIS (US Sales Only); INIS		DE93630438	
11292	18:26578	OSTI; NTIS (US Sales Only); INIS		DE93630439	
11300	18:26579	OSTI; NTIS (US Sales Only); INIS		DE93630440	
11301	18:26580	OSTI; NTIS (US Sales Only); INIS		DE93630441	
11302	18:26581	OSTI; NTIS (US Sales Only); INIS		DE93630442	
11303	18:26582	OSTI; NTIS (US Sales Only); INIS		DE93630443	
11304	18:28031	OSTI; NTIS (US Sales Only); INIS		DE93632041	
11305	18:26583	OSTI; NTIS (US Sales Only); INIS		DE93630405	
11307	18:25630	OSTI; NTIS (US Sales Only); INIS		DE93630996	
11308	18:27604	OSTI; NTIS (US Sales Only); INIS		DE93630798	
11311	18:26584	OSTI; NTIS (US Sales Only); INIS		DE93630444	
CEA-DES–					
110	18:26126	OSTI; NTIS (US Sales Only); INIS		DE93631497	
115	18:26346	OSTI; NTIS (US Sales Only); INIS		DE93631525	
CEA-LNS-GT–					
92-06	18:27172	OSTI; NTIS (US Sales Only); INIS		DE93631539	
92-09	18:26994	OSTI; NTIS (US Sales Only); INIS		DE93631091	
CEA-LNS-GT-ME–					
92-08	18:26995	OSTI; NTIS (US Sales Only); INIS		DE93631090	
CEA-LNS-Ph–					
92-04	18:27835	OSTI; NTIS (US Sales Only); INIS		DE93631870	
CEA-N–					
2709	18:27864	OSTI; NTIS (US Sales Only); INIS		DE93631898	
CEA-R–					
5621	18:26737	OSTI; NTIS (US Sales Only); INIS		DE93630460	
5624	18:27173	OSTI; NTIS (US Sales Only); INIS		DE93631550	
5628	18:25643	OSTI; NTIS (US Sales Only); INIS		DE93630365	
5632	18:26895	OSTI; NTIS (US Sales Only); INIS		DE93631011	
CEAC-R–					
1-93	18:26837	OSTI; NTIS (US Sales Only); INIS		DE93630289	
CEBAF-TH–					
92-13	18:27798	*See* RAL–92-026			
CERN-SL–					
92-49(AP)	18:27015	*See* LBL–33091			
CERN-TH–					
6421/92.	18:27789	*See* LAL–92-09			
CIEMAT–					
706	18:27936	OSTI; NTIS		DE93502571	
707	18:27937	OSTI; NTIS		DE93502572	
708	18:28095	OSTI; NTIS		DE93502573	
709	18:27938	OSTI; NTIS		DE93502574	
710	18:27939	OSTI; NTIS		DE93502575	
711	18:27940	OSTI; NTIS		DE93502576	
713	18:27941	OSTI; NTIS		DE93502577	
CONF-8106349–		(2. International conference on superplasticizers in concrete; Ottawa (Canada); 10-12 Jun 1981)			
1	18:26934	*See* CBL–40			
CONF-8706430–		(3. Seminarium EII, MPI, NINI on Technological Specialities.; Salazar (Mexico); 11 Jun 1987)			
	18:27426	*See* INIS-mf–13542			

CONF-880912–

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-880912–		(196. American Chemical Society (ACS) national meeting; Los Angeles, CA (United States); 25-30 Sep 1988)			
35	18:25545	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012935	MF-108
CONF-890902–		(198. national meeting of the American Chemical Society (ACS); Miami, FL (United States); 10-15 Sep 1989)			
30	18:25478	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012938	MF-108
CONF-8910496–		(14. annual symposium of the ACIESP; Sao Paulo (Brazil); 9-13 Oct 1989)			
	18:25718	*See* IPEN-PUB–375			
CONF-9005247–		(International conference on radiation material science; Alushta (USSR); 22-25 May 1990)			
	18:26610	*See* INIS-mf–13544			
	18:26628	*See* INIS-mf–13545			
	18:26652	*See* INIS-mf–13546			
	18:26677	*See* INIS-mf–13547			
CONF-9005443–		(8. international congress on nitrogen fixation; Knoxville, TN (United States); 20 May 1990)			
	18:25942	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015341	MF-408
CONF-900549–		(International conference on non-destructive evaluation (NDE)in the nuclear industry; Glasgow (United Kingdom); 4-7 Jun 1990)			
	18:26125	*See* CEA-CONF–11288			
CONF-900922–		(Workshop on removal of particles from upper atmosphere by means of electromagnetic and plasma waves: active global experiments; Varenna (Italy); 5-12 Sep 1990)			
1	18:27373	*See* UCRL-JC–110318			
CONF-9009248–		(19. international congress on high speed photography and photonics; Cambridge (United Kingdom); 16-22 Sep 1990)			
	18:27175	*See* CRN-CPR–90-06			
CONF-9010138–		(International congress on microbially influenced corrosion; Knoxville, TN (United States); 7-12 Oct 1990)			
	18:26576	*See* CEA-CONF–11290			
CONF-9010356–		(Symposium on Zirconium New Material for the Chemical Industry; Lyon (France); 10-11 Oct 1990)			
	18:26584	*See* CEA-CONF–11311			
CONF-901231–		(IRPA regional congress: sea dumping of low level radioactive waste-scientific radiation protection considerations; Paris (France); 11-12 Dec 1990)			
1	18:25706	*See* ENEA-RT-AMB–91-15			
CONF-9101167–		(International conference on quantum optics; Hyderabad (India); 5-10 Jan 1991)			
1	18:27881	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013438	MF-410
CONF-9101168–		(Joint seminar on solid state physics, atomic and molecular physics, and material science in the energy region of tandem accelerators; Tokai (Japan); 22-23 Jan 1991)			
	18:27848	*See* JAERI-M–92-202			
CONF-910414–		(International topical meeting on advances in mathematics, computation and reactor physics; Pittsburgh, PA (United States); 28 Apr - 2 may 1991)			
41	18:28096	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015816	MF-405
CONF-910422–		(International topical conference on methods and applications of radioanalytical chemistry II (MARC-2); Kona, HI (United States); 21-27 Apr 1991)			
11	18:27213	*See* UCRL-JC–105283			
CONF-9105216–		(Symposium on inorganic mass spectrometry; Durango, CO (United States); 7-9 May 1991)			
	18:26848	*See* LA–12522-C			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-9106209–		(International Atomic Energy Agency (IAEA) technical committee meeting on alpha particles in fusion; Aspenas (Sweden); 10-14 Jun 1991)			
7	18:27966	*See* ENEA-RT-NUCL–91-21			
CONF-9106235–		(11. Department of Energy workshop on personnel neutron dosimetry; Las Vegas, NV (United States); 4-7 Jun 1991)			
	18:27632	*See* PNL-SA–21596			
CONF-9106293–		(18. European conference on controlled fusion and plasma heating; Berlin (Germany); 3-7 Jun 1991)			
Exc.	18:27952	*See* ENEA-RT-NUCL–91-07			
CONF-9106431–		(CEC/ICMC conference; Huntsville, AL (United States); 11-14 Jun 1991)			
1	18:27047	*See* FNAL/C–92/94			
CONF-9106433–		(7. International Magnetic Measurement Workshop (IMMW-7); Darmstadt (Germany); 18-21 Jun 1991)			
	18:27157	*See* IFVE-OUNK–91-178			
CONF-910711–		(20. international conference on phenomena in ionized gases; Barga (Italy); 8-12 Jul 1991)			
Exc.	18:27962	*See* ENEA-RT-NUCL–91-08			
CONF-9107262–		(20. international conference on phenomena in ionized gases; Pisa (Italy); 8-12 Jul 1991)			
1	18:26935	*See* ENEA-RT-INN–91-17			
CONF-910817–		(11. international conference on structural mechanics in reactor technology (SMIRT-11); Tokyo (Japan); 18-23 Aug 1991)			
34	18:28040	*See* ENEA-RT-NUCL–91-06			
CONF-910836–		(19. Stanford Linear Accelerator Center (SLAC) summer institute on particle physics; Stanford, CA (United States); 5-16 Aug 1991)			
6	18:27799	*See* SLAC-PUB–5832			
CONF-910862–		(Pacific-international congress on x-ray analytical methods; Honolulu, HI (United States); 12-16 Aug 1991)			
9	18:26855	*See* UCRL-JC–104107			
CONF-910905–		(5. international symposium on the natural radiation environment; Salzburg (Austria); 22-28 Sep 1991)			
5	18:27605	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014035	MF-407
CONF-9109221–		(21. international symposium on multiparticle dynamics; Wuhan (China); 23-27 Sep 1991)			
7	18:27746	*See* DOE/ER/40224–232			
CONF-9109349–		(Accelerator physics and modeling; Upton, NY (United States); 17 Sep 1991)			
2	18:26993	*See* BNL–48958			
CONF-9109491–		(International Symposium on Marine and Microbial Corrosion; Stockholm (Sweden); 30 Sep - 2 oct 1991)			
	18:26578	*See* CEA-CONF–11292			
CONF-911001–		(International conference on fast reactor systems and fuel cycles; Kyoto (Japan); 27 Oct - 1 nov 1991)			
29	18:26194	*See* ENEA-RT-NUCL–92-09			
CONF-9110369–		(3. Joint Department of Energy/National Science Foundation (DOE/NSF) workshop on flow of particulates and fluids; Worcester, MA (United States); 22-24 Oct 1991)			
3	18:26929	*See* UCRL-JC–109143			
CONF-9110505–		(INS two-day meeting on roles of Pauli principle in few-body problems; Tanashi (Japan); 30-31 Oct 1991)			
	18:27820	*See* INS-T–518			
CONF-911105–		(Symposium on implications of the new ICRP recommendations on radiological protection practices; Salamanca (Spain); 26-29 Nov 1991)			
Exc.	18:28042	*See* ENEA-RT-NUCL–91-19			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-911111–		(5. international conference on fusion reactor materials (ICFRM-5); Clearwater, FL (United States); 17-22 Nov 1991)			
	18:26579	*See* CEA-CONF–11300			
	18:26580	*See* CEA-CONF–11301			
	18:26581	*See* CEA-CONF–11302			
	18:26582	*See* CEA-CONF–11303			
42	18:28044	*See* ENEA-RT-NUCL–91-22			
CONF-9111321–		(RAINA-seminar; Espoo (Finland); 14 Nov 1991)			
	18:26527	*See* KCL-RAINA–6			
CONF-911288–		(Applications of the Advanced Light Source to problems in the earth, soil, and environmental sciences; San Francisco, CA (United States); 11 Dec 1991)			
	18:27910	*See* LBL–31852			
CONF-911296–		(14. international conference on laser and applications; San Diego, CA (United States); 8-13 Dec 1991)			
10	18:26726	*See* UCRL-JC–109917			
CONF-920003–		(1992 IEA workshop; Garpenberg (Sweden); 1992)			
	18:25945	*See* SLU-SKOPRO-R–33			
CONF-9201150–		(International CHALLENGE symposium; Laxenburg (Austria); 30-31 Jan 1992)			
1	18:27272	*See* BNL–48755			
CONF-920140–		(30. winter meeting on nuclear physics; Bormio (Italy); 27 Jan - 1 feb 1992)			
	18:27859	*See* LPCC–92-02			
CONF-9202136–		(Nuclear DECOM '92: decommissioning of radioactive facilities international conference; London (United Kingdom); 17-19 Feb 1992)			
1	18:25638	*See* ENEA-RTI-PCM-IFEC–92-04			
CONF-9202180–		(Environmental regulations course for Federal Facilities and Government contractors; Idaho Falls, ID (United States); 8-10 Feb 1992)			
1	18:26542	*See* WINCO–11914			
CONF-9202182–		(NAG European technical seminar: Numerical and symbolic computations; Bologna (Italy); 18 Feb 1992)			
1	18:26940	*See* ETDE-IT–93-180			
CONF-920307–		(Waste management '92; Tucson, AZ (United States); 1-5 Mar 1992)			
92	18:25814	*See* WSRC-MS–92-033			
CONF-920311–		(10. international conference on plasma-surface interactions in controlled fusion devices; Monterey, CA (United States); 30 Mar - 3 apr 1992)			
Exc.	18:28046	*See* ENEA-RT-NUCL–92-12			
CONF-9203139–		(Laser guide star adaptive optics workshop; Albuquerque, NM (United States); 10-12 Mar 1992)			
5-Rev.2	18:27223	*See* UCRL-JC–109219-Rev.2			
CONF-920318–		(International workshop on dynamical fluctuations and correlations in nuclear collisions; Aussois (France); 12-20 Mar 1992)			
	18:27860	*See* LPCC–92-03			
CONF-9203247–		(2. conference on earthquake hazards in the Eastern San Francisco Bay area; Hayward, CA (United States); 25-27 Mar 1992)			
1	18:27461	*See* UCRL-JC–108210			
CONF-9203258–		(National Electrical Testing Association meeting; Charleston, SC (United States); 19 Mar 1992)			
1	18:26556	*See* UCRL-JC–109347			
CONF-9203262–		(R&D on volume and mass measurements in liquids; Ispra (Italy); 25-27 Mar 1992)			
1	18:25889	*See* ENEA-RT-NUCL–92-08			
CONF-9203266–		(French-Brazilian Materials Sciences Symposium; Ouro Preto (Brazil); 16-21 Mar 1992)			
	18:25625	*See* IPEN-PUB–373			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-920331–		(4. international industrial symposium on the Super Collider; New Orleans, LA (United States); 4-6 Mar 1992)			
73	18:27048	*See* FNAL/C–92/98			
74	18:27038	*See* BNL–47596			
CONF-9204102–		(6. symposium on electromagnetic launch technology; Austin, TX (United States); 28-30 Apr 1992)			
10	18:26915	*See* UCRL-JC–110265			
CONF-9204112–		(2. small satellite technology and applications; Orlando, FL (United States); 20-24 Apr 1992)			
3	18:27264	*See* UCRL-JC–110273			
CONF-9204120–		(Soft-x-ray projection lithography topical meeting; Monterey, CA (United States); 6-8 Apr 1992)			
9-Rev.1	18:26724	*See* UCRL-JC–109359-Rev.1			
CONF-9204142–		(DNA numerical methods symposium; Menlo Park, CA (United States); 28 Apr 1992)			
2	18:26930	*See* UCRL-JC–111404			
CONF-9204242–		(Environmental dimensions of the Gulf: policy and institutional perspectives workshop; Al-Ain (United Arab Emirates); 19-22 Apr 1992)			
1	18:27374	*See* UCRL-JC–110365			
CONF-9204252–		(Technical committee meeting on fission gas release and fuel rod chemistry related to extended burnup; Pembroke (Canada); 28 Apr - 1 may 1992)			
	18:26246	*See* IAEA-TECDOC–697			
CONF-9205138–		(North American Ingres Users Association (NAIUA) meeting; Tarpan Springs, FL (United States); May 1992)			
4	18:26914	*See* UCRL-JC–110007			
CONF-9205173–		(International symposium on transport theory; Moscow (Russian Federation); 23-31 May 1992)			
1-Vugraphs	18:27865	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015824	MF-506
CONF-920523–		(3. international colloquium on x-ray lasers; Schliersee (Germany); 18-22 May 1992)			
14	18:26953	*See* UCRL-JC–110706			
CONF-9205232–		(11. American Society for Testing and Materials (ASTM) symposium on composite materials: testing and design; Pittsburgh, PA (United States); 4-5 May 1992)			
2	18:26821	*See* UCRL-JC–107836			
CONF-9205354–		(5. Spring School on acousto-optics and applications; Gdansk/Jurata (Poland); 25-29 May 1992)			
1	18:27728	*See* UCRL-JC–111951			
CONF-920556–		(International symposium on measurement of toxic and related air pollutants; Durham, NC (United States); 4-8 May 1992)			
1	18:27271	*See* BNL–48499			
CONF-920575–		(Symposium on electron, ion and photon beams; Orlando, FL (United States); 26-29 May 1992)			
1	18:26956	*See* UCRL-JC–112163			
CONF-920604–		(7. world conference and exhibition on titanium; San Diego, CA (United States); 28 Jun - 2 jul 1992)			
4	18:26700	*See* KAPL–4737			
CONF-920610–		(ICPP 92: International conference on plasma physics; Innsbruck (Austria); 29 Jun - 3 jul 1992)			
16	18:28027	*See* UCRL-JC–111546			
Exc.	18:27968	*See* ENEA-RT-NUCL–92-14			
CONF-9206138–		(5. topical meeting on optical interference coating; Tucson, AZ (United States); 1-5 Jun 1992)			
3	18:26938	*See* ETDE-IT–93-169			
4	18:26939	*See* ETDE-IT–93-170			

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CONF-9206172–		(Solid state sensor and actuator workshop; Hilton Head Island, SC (United States); 21-25 Jun 1992)			
4	18:26951	*See* UCRL-JC–109341			
CONF-9206342–		(Potential for small and medium sized wind energy application in Mediterranean countries; Rodi (Greece); 25-27 Jun 1992)			
2	18:26068	*See* ETDE-IT–93-178			
CONF-9206359–		(International conference on plasma physics (ICPP) - joint conference of the 9. Kiev international conference on plasma theory and the 9. international congress on waves and stabilities in plasma (ICWI; Innsbruck (Austria); 29 Jun - 3 jul 1992)			
1	18:28025	*See* UCRL-JC–110953			
CONF-9206360–		(North Atlantic Treaty Organization (NATO)-ASI meeting on recent problems in mathematical physics; Salamanca (Spain); Jun 1992)			
1	18:27671	*See* DOE/ER/40757–004			
CONF-9206370–		(104. annual meeting of the Astronomical Society of the Pacific; Madison, WI (United States); 20-25 Jun 1992)			
1	18:27727	*See* UCRL-JC–111860			
CONF-9206372–		(12. conference on probability and statistics in the atmospheric sciences; Ontario (Canada); 22-26 Jun 1992)			
1	18:27669	*See* UCRL-JC–109870			
CONF-9206374–		(Workshop on postlabeling methods on DNA adducts; Lyon (France); 24-27 Jun 1992)			
1	18:27651	*See* UCRL-JC–111534			
CONF-9206381–		(Technical committee meeting on advances in simulation and modelling of thermonuclear plasmas; Varennes (Canada); 15-17 Jun 1992)			
1	18:27980	*See* ETDE-IT–93-167			
CONF-920673–		(16. annual symposium of American Society of Testing and Materials (ASTM) on effects of radiation on materials; Denver, CO (United States); 21-25 Jun 1992)			
19	18:26585	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015825	MF-404
CONF-920706–		(International conference on high energy accelerators; Hamburg (Germany); 20-24 Jul 1992)			
53	18:27148	*See* UCRL-JC–109740			
54	18:27093	*See* SLAC-PUB–6098			
CONF-9207198–		(Santa Cruz workshop on the galaxy – globular cluster connection; Santa Cruz, CA (United States); Jul 1992)			
1	18:27726	*See* UCRL-JC–111689			
CONF-9207201–		(Statistics and computing in disease clustering; Stony Brook, NY (United States); 23-24 Jul 1992)			
1-Rev.1	18:27526	*See* LBL–32641-Rev.1			
CONF-9207206–		(Utilizzo delle biomasse agricole nella produzione energetica; Saluggia (Italy); 2 Jul 1992)			
1	18:25964	*See* ETDE-IT–93-166			
CONF-9207207–		(European powder diffraction conference; Enschede (Netherlands); 30 Jul - 1 aug 1992)			
1	18:26607	*See* ETDE-IT–93-185			
CONF-920721–		(6. international conference on nuclei far from stability and 9th international conference on atomic masses and fundamental constants; Bernkastel-Kues (Germany); 19-24 Jul 1992)			
15	18:27836	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013889	MF-413
16	18:27813	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015337	MF-413
CONF-920792–		(Society of Photo-Optical Instrumentation Engineers (SPIE) international symposium on optical applied science and engineering; San Diego, CA (United States); 19-24 Jul 1992)			
52	18:27214	*See* UCRL-JC–109421			
57	18:25909	*See* UCRL-JC–109276			

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59	18:27233	*See* UCRL-JC–111801			
61	18:26774	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015304	MF-401; MF-404
63	18:27215	*See* UCRL-JC–111941			
65	18:26954	*See* UCRL-JC–111213			
CONF-920803–		(Nuclear technologies for space exploration; Jackson, WY (United States); 16-19 Aug 1992)			
18	18:26208	*See* WHC-SA–1420			
CONF-9208109–		(16. international LINAC conference; Ottawa (Canada); 23-28 Aug 1992)			
83	18:27149	*See* UCRL-JC–110198			
85	18:27150	*See* UCRL-JC–110200			
86	18:27030	*See* UCRL-JC–110203			
88	18:28064	*See* UCRL-JC–110213			
CONF-920813–		(Joint Varenna-Lausanne international workshop on theory of fusion plasmas; Varenna (Italy); 24-28 Aug 1992)			
3	18:28026	*See* UCRL-JC–111405			
4	18:27978	*See* ETDE-IT–93-159			
5	18:27982	*See* ETDE-IT–93-171			
6	18:27983	*See* ETDE-IT–93-172			
CONF-9208132–		(1992 international conference on science and technology of synthetic metals (ICSM); Goeteborg (Sweden); 12-18 Aug 1992)			
13	18:26772	*See* ANL/MSD/CP–79640			
CONF-9208135–		(International conference on the physics of strongly coupled plasmas; Rochester, NY (United States); 17-21 Aug 1992)			
7	18:26874	*See* UCRL-JC–112346			
CONF-9208142–		(14. international free electron laser conference; Kobe (Japan); 23-28 Aug 1992)			
22	18:28065	*See* UCRL-JC–111690			
CONF-920815–		(204. American Chemical Society (ACS) national meeting; Washington, DC (United States); 23-28 Aug 1992)			
21	18:25961	*See* UCRL-JC–110663			
23	18:26437	*See* TVA-Circ.–Z-321			
CONF-9208160–		(7. international conference on x-ray absorption fine structure; Kobe (Japan); 23-29 Aug 1992)			
7	18:27883	*See* DOE/ER/45415–6			
CONF-9208164–		(6. symmetries in science; Bregenz (Austria); 2-7 Aug 1992)			
3	18:27934	*See* DOE/ER/40561–084			
CONF-9208184–		(Anomalous scattering international conference; Malente (Germany); 17-21 Aug 1992)			
2	18:26586	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015906	MF-404
CONF-9208186–		(International conference on anomalous scattering (ICAS); Hamburg (Germany); 17-21 Aug 1992)			
2	18:27908	*See* BNL–48895			
3	18:27880	*See* ANL/PHY/CP–79637			
CONF-9208207–		(1992 coatings for advanced heat engines workshop; Monterey, CA (United States); 2 Aug 1992)			
2	18:26738	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015488	MF-332
CONF-9208220–		(Environmental realities in the the '90s: TVA's agricultural/environmental conference; St. Louis, MO (United States); 26 Aug 1992)			
	18:26539	*See* TVA-Bull–Y-229			
CONF-9208221–		(International workshop on surface x-ray absorption fine structure (XAFS); Jaipur (India); Aug 1992)			
2	18:27867	*See* DOE/ER/45415–9			
CONF-9208222–		(3. International Workshop on Separation Phenomena in Liquids and Gases; Charlottesville, VA (United States); 18 Aug 1992)			
	18:25630	*See* CEA-CONF–11307			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-9208223–		(Mathematics and sciences education summit; Fripp Island, SC (United States); 28-30 Aug 1992)			
Summ.	18:28072	*See* DOE/ER/75842–1			
CONF-9208224–		(31. annual conference of metallurgists on materials performance, sulphur and energy; Edmonton (Canada); 24-27 Aug 1992)			
1	18:26604	*See* DOE/ER/45461–9			
CONF-9208225–		(Advanced light source users meeting; Berkeley, CA (United States); 27-28 Aug 1992)			
1	18:26732	*See* UCRL-JC–111973			
CONF-9208231–		(World bujatric congress and American association of bovine practitioner; St. Paul, MN (United States); 31 Aug 1992)			
1	18:27611	*See* ETDE-IT–93-160			
CONF-920851–		(Spectrum '92: nuclear and hazardous waste management international topical meeting; Boise, ID (United States); 23-27 Aug 1992)			
95	18:25644	*See* ETDE-IT–93-195			
95	18:25707	*See* ETDE-IT–93-156			
97	18:25607	*See* UCRL-JC–110348			
CONF-920866–		(American Society of Civil Engineers (ASCE) symposium on dynamic analysis and design considerations, for high-level nuclear waste repositories; San Francisco, CA (United States); 19-20 Aug 1992)			
6	18:25880	*See* UCRL-JC–110983			
7	18:25682	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013508	MF-814
CONF-920905–		(PATRAM '92: 10th international symposium on the packaging and transportation of radioactive materials; Yokohama (Japan); 13-18 Sep 1992)			
	18:25652	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013222	MF-940
CONF-920906–		(15. congress of the World Energy Council (WEC): energy and life; Madrid (Spain); 20-25 Sep 1992)			
4	18:26451	*See* ETDE-IT–93-174			
CONF-920909–		(8. international meeting on radiation processing; Beijing (China); 14-19 Sep 1992)			
	18:27046	*See* ETDE-IT–93-184			
CONF-9209159–		(Eurocourse: technologies for environmental cleanup - soil and groundwater; Ispra (Italy); 21-25 Sep 1992)			
8	18:27462	*See* UCRL-JC–111993			
CONF-9209189–		(Industrial applications of plasma physics workshop; Varenna (Italy); 2-12 Sep 1992)			
3	18:27981	*See* ETDE-IT–93-168			
CONF-9209239–		(Workshop on nuclear physics in the universe; Oak Ridge, TN (United States); 24-26 Sep 1992)			
6	18:27725	*See* UCRL-JC–111448			
CONF-9209243–		(Advisory group meeting on nuclear data requirements for fission reactor decommissioning; Vienna (Austria); 7-11 Sep 1992)			
2	18:25890	*See* ETDE-IT–93-179			
CONF-9209253–		(Crystal 2000 international workshop on heavy scintillators for scientific and industrial applications; Chamonix (France); 22-26 Sep 1992)			
	18:27191	*See* GANIL-P–92-25			
5	18:26775	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015499	MF-401; MF-406
CONF-9209263–		(3. international conference on calorimetry in high energy physics; Corpus Christi, TX (United States); 29 Sep - 2 oct 1992)			
13	18:27174	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013490	MF-414
CONF-920927–		(2. international conference and exhibition on computer applications to materials and molecular science and engineering; Yokohama (Japan); 22-25 Sep 1992)			
4	18:26725	*See* UCRL-JC–109651			

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CONF-920930–		(17. symposium on fusion technology; Rome (Italy); 14-18 Sep 1992)			
	18:26583	*See* CEA-CONF–11305			
	18:28031	*See* CEA-CONF–11304			
17	18:28039	*See* ENEA-RTI-PCM-IFEC–92-06			
CONF-9209307–		(International workshop on laser deposition of advanced materials; Tito (Italy); 28-30 Sep 1992)			
2	18:26795	*See* ETDE-IT–93-176			
CONF-9209344–		(3. international symposium on current problems in rheology, biorheology and biomechanics; Moscow (Russian Federation); 1-5 Sep 1992)			
1	18:26920	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012540	MF-406
CONF-9209356–		(Specialists meeting/workshop on the potential of knowledge based systems in nuclear installations; Erlangen (Germany); 21-25 Sep 1992)			
	18:26256	*See* IAEA-TECDOC–700			
CONF-9209360–		(3. international workshop on materials and mechanics issues of solder alloy applications; Santa Fe, NM (United States); 9-11 Sep 1992)			
1	18:26710	*See* LBL–34012			
CONF-9209363–		(Workshop on 'Ten Years of Susy Confronting Experiment'; Geneva (Switzerland); 7-9 Sep 1992)			
	18:27805	*See* LAL–92-59			
CONF-9209365–		(Conference on reactivity accidents of nuclear reactors; Kiev (Russian Federation); 28 Sep - 3 oct 1992)			
	18:26346	*See* CEA-DES–115			
CONF-9209366–		(International chromatography symposium 1992; Linz (Austria); 21-24 Sep 1992)			
1	18:27488	*See* ETDE-IT–93-173			
CONF-9209367–		(NAGUA '92 users conference; Canterbury (United Kingdom); 9-11 Sep 1992)			
1	18:26937	*See* ETDE-IT–93-162			
CONF-9209369–		(8. international colloquium for the optimization of plant nutrition; Lisbon (Portugal); 1-5 Sep 1992)			
1	18:27407	*See* ETDE-IT–93-175			
CONF-9209375–		(Workshop on safety, reliability and condition monitoring of wind turbines; Nottingham (United Kingdom); 17 Sep 1992)			
	18:26069	*See* ETSU-N–124			
CONF-920944–		(6. annual New York State Institute on Superconductivity (NYSIS) conference on superconductivity and applications; Buffalo, NY (United States); 15-17 Sep 1992)			
7	18:27907	*See* BNL–48361			
CONF-920948–		(6. international conference on physics of highly charged ions; Manhattan, KS (United States); 28 Sep - 2 oct 1992)			
13	18:27893	*See* UCRL-JC–111717			
CONF-920966–		(10. conference on computing in high energy physics; Annecy (France); 21-25 Sep 1992)			
25-Rev.1	18:28196	*See* UCRL-JC–111816-Rev.1			
CONF-921003–		(International conference on design and safety of advanced nuclear power plants; Tokyo (Japan); 25-28 Oct 1992)			
11	18:26131	*See* EGG-M–92494			
12	18:26229	*See* ETDE-IT–93-187			
CONF-921005–		(Institute of Electrical and Electronic Engineers (IEEE) nuclear science symposium and medical imaging conference; Orlando, FL (United States); 26-31 Oct 1992)			
34	18:28190	*See* SLAC-PUB–5967			
CONF-921007–		(20. water reactor safety information meeting; Bethesda, MD (United States); 21-23 Oct 1992)			
25	18:26343	*See* BNL-NUREG–47879			
29	18:26252	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015448	

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30	18:26347	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015187	
31	18:26348	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015520	
32	18:26587	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015460	
33	18:26250	*See* BNL-NUREG–48522			
CONF-9210161–		(12. international vacuum congress; 8. international conference on solid surfaces; Hague (Netherlands); Hague (Netherlands); 12-16 Oct 1992; 12-16 oct 1992)			
5	18:27155	*See* BNL–48367			
CONF-9210162–		(12. international vacuum congress; 8. international conference on solid surfaces; Hague (Netherlands); Hague (Netherlands); 12-16 Oct 1992; 12-16 oct 1992)			
4	18:27155	*See* BNL–48367			
CONF-9210173–		(Nuclear Energy Agency Science Committee (NEANSC) specialists meeting on evaluation and processing of covariance data; Oak Ridge, TN (United States); 7-9 Oct 1992)			
6	18:27837	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015798	MF-413
CONF-9210194–		(International symposium on environmental contamination in Central and Eastern Europe; Budapest (Hungary); 12-16 Oct 1992)			
11	18:27489	*See* ETDE-IT–93-177			
CONF-921020–		(Cement industry solutions to waste management; Calgary (Canada); 7-9 Oct 1992)			
4	18:26524	*See* ETDE-IT–93-158			
CONF-9210209–		(Organization for Economic Co-Operation Development/International Atomic Energy Agency/Commission of Safety Nuclear Installations (OECD/IAEA/CSNI) joint international specialists meeting on fracture mechanics verification by large scale testing; Knoxville, TN (United States); 26-29 Oct 1992)			
3	18:26127	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015447	
CONF-9210231–		(26. annual Asilomar conference on signals, systems, and computers; Pacific Grove, CA (United States); 25-30 Oct 1992)			
4	18:27242	*See* UCRL-JC–112103			
CONF-9210297–		(Mixed waste regulation conference; Albuquerque, NM (United States); 26-27 Oct 1992)			
1	18:25745	*See* PNL-SA–21482			
CONF-9210334–		(17. annual climate diagnostics conference; Norman, OK (United States); 19-23 Oct 1992)			
2	18:27508	*See* UCRL-JC–112367			
CONF-9210352–		(Annual meeting of the fertilizer industry round table; Baltimore, MD (United States); 26-28 Oct 1992)			
1	18:26540	*See* TVA-Circ.–Z-325			
CONF-9210354–		(IPCC international workshop on biotic feedbacks in the global climate system; Woods Hole, MA (United States); 25-29 Oct 1992)			
1	18:27385	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013530	MF-402
CONF-9210357–		(3. international symposium on software reliability engineering; Triangle Park, NC (United States); 7-9 Oct 1992)			
1	18:28193	*See* UCRL-JC–109851			
CONF-9210367–		(International seminar on the frontier of nuclear spectroscopy; Kyoto (Japan); 23-24 Oct 1992)			
1	18:27809	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015814	MF-413
CONF-9210368–		(6. Franco-Japanese Colloquium on nuclear structures and inter-disciplinary topics; St. Malo (France); 6-10 Oct 1992)			
	18:27823	*See* IPNO-DRE–92-36			
CONF-9210369–		(International Conference on Corrosion, deformation interactions; Fontainebleau (France); 5-7 Oct 1992)			
	18:26577	*See* CEA-CONF–11291			

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CONF-9210371–		(12. international vacuum congress; The Hague (Netherlands); 12-16 Oct 1992)			
1	18:25998	*See* ETDE-IT–93-193			
CONF-9210372–		(Workshop on the rational use of energy; Budapest (Hungary); 27-29 Oct 1992)			
1	18:26049	*See* ETDE-IT–93-154			
2	18:26523	*See* ETDE-IT–93-155			
3	18:26557	*See* ETDE-IT–93-191			
CONF-9210373–		(Workshop on high temperature electrode materials; Roskilde (Denmark); 26-27 Oct 1992)			
Absts.	18:26484	*See* NEI-DK–1194			
CONF-9210377–		(2. conference on industrial cooperation between Arab Gulf states and European community; Doha (Qatar); 25 Oct 1992)			
	18:25616	*See* INIS-mf–13563			
CONF-9210382–		(2. JAERI symposium on HTGR technologies; Oarai (Japan); 21-23 Oct 1992)			
	18:26165	*See* JAERI-M–92-215			
CONF-921046–		(Symposium on nuclear data evaluation methodology; Upton, NY (United States); 12-16 Oct 1992)			
18	18:28028	*See* UCRL-JC–112154			
19	18:27810	*See* UCRL-JC–110651			
21	18:27827	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015969	MF-413
CONF-921047–		(Symposium on optical materials for high-power lasers; Boulder, CO (United States); 28-30 Oct 1992)			
3	18:26945	*See* LA-UR–93-1212			
CONF-921077–		(Stability of particle motion in storage rings; Upton, NY (United States); 18-24 Oct 1992)			
5	18:27049	*See* FNAL/C–93/075			
CONF-921079–		(Visualization 1992; Boston, MA (United States); 19-23 Oct 1992)			
5	18:28194	*See* UCRL-JC–110110			
CONF-921101–		(16. Material Research Society international symposium on the scientific basis for nuclear waste management fall meeting; Boston, MA (United States); 30 Nov - 5 dec 1992)			
115	18:26729	*See* UCRL-JC–110687			
116	18:26588	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012960	MF-310
119	18:26825	*See* UCRL-JC–112408			
120	18:26733	*See* UCRL-JC–112067			
121	18:26731	*See* UCRL-JC–111304			
122	18:26730	*See* UCRL-JC–111000			
123	18:26739	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015491	MF-404
125	18:26838	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015333	MF-406
126	18:26740	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015449	MF-404
128	18:27911	*See* LBL–34118			
129	18:26741	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015511	MF-404
130	18:26776	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015365	MF-404
131	18:26742	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015363	MF-404
132	18:26589	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015336	MF-404
133	18:26743	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015339	MF-404
CONF-921103–		(Meeting of the Division of Plasma Physics of the American Physical Society; Seattle, WA (United States); 16-20 Nov 1992)			
11-App.B	18:27942	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013487	MF-427
12-App.A	18:27943	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013488	MF-427
13-App.C	18:28032	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013489	MF-427
CONF-921109–		(Fall meeting of the Metallurgical Society and American Institute of Metallurgical and Petroleum Engineers; Chicago, IL (United States); 1-5 Nov 1992)			
5	18:26727	*See* UCRL-JC–110128			
6	18:26590	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015453	MF-404
7	18:26591	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015454	
CONF-921110–		(Winter annual meeting of the American Society of Mechanical Engineers (ASME); Anaheim, CA (United States); 8-13 Nov 1992)			
50	18:26913	*See* UCRL-JC–108924			
51	18:26723	*See* UCRL-JC–107859			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-9211101–		(Annual automotive development technology contractors' coordination meeting; Dearborn, MI (United States); 2-5 Nov 1992)			
11	18:26744	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015894	MF-332
CONF-9211104–		(OPTCON '92: optical fabrication and testing workshop; Boston, MA (United States); 17 Nov 1992)			
9	18:26822	*See* UCRL-JC–111397			
CONF-9211110–		(Microstructure and mechanical properties of aging materials; Detroit, MI (United States); 2-5 Nov 1992)			
2	18:26592	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015489	MF-504
CONF-9211112–		(Conference on managing nuclear weapons in a changing world; Livermore, CA (United States); 17-18 Nov 1992)			
1	18:26565	*See* UCRL-JC–113281			
CONF-9211117–		(Minerals, Metals, and Materials Society/American Society for Metals (TMS/ASM) materials week '92; Chicago, IL (United States); 2-5 Nov 1992)			
9	18:26593	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015307	MF-404
CONF-9211128–		(1992 nuclear explosives code developers conference; Sunnyvale, CA (United States); 2-6 Nov 1992)			
8	18:28029	*See* UCRL-JC–112302			
CONF-9211172–		(International workshop on B factories: accelerators and experiments; Tsukuba (Japan); 17-20 Nov 1992)			
6	18:27167	*See* SLAC-PUB–6035			
CONF-9211199–		(Symposium on nuclear physics of our times; Sanibel Island, FL (United States); 17-21 Nov 1992)			
8	18:27814	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015484	MF-413
CONF-9211205–		(High-temperature ordered intermetallic alloys V; Boston, MA (United States); 30 Nov - 3 dec 1992)			
2	18:26594	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015308	MF-310; MF-114
CONF-9211215–		(1. ERS-1 symposium: space in the service of our environment; Cannes (France); Nov 1992)			
1	18:27474	*See* BNL–48476			
CONF-921122–		(Meeting of the Division of Particles and Fields of the American Physical Society; Batavia, IL (United States); 10-14 Nov 1992)			
52	18:27777	*See* FNAL/C–93/045/E			
53	18:27778	*See* FNAL/C–93/048/E			
57	18:27186	*See* FNAL/C–93/049-E			
60	18:27779	*See* FNAL/C–93/050-E			
61	18:27780	*See* FNAL/C–93/055-E			
62	18:27776	*See* FNAL/C–93/044-E			
63	18:27185	*See* FNAL/C–93/046-E			
66	18:27775	*See* FNAL/C–92/345-E			
CONF-9211241–		(Conference on provisions against radon; Jihlava (Czech Republic); 23-25 Nov 1992)			
	18:27332	*See* INIS-mf–13543			
CONF-9211243–		(35. Congresso Nacional de Fisica; Puebla (Mexico); Nov 1992)			
1	18:27802	*See* DOE/ER/40427–02-N93			
CONF-921125–		(ACM/IEEE supercomputing conference; Minneapolis, MN (United States); 14-21 Nov 1992)			
7	18:28195	*See* UCRL-JC–111558-Rev.1			
CONF-921129–		(39. national symposium of the American Vacuum Society; Chicago, IL (United States); 9-13 Nov 1992)			
10	18:26819	*See* SLAC-PUB–6078			
CONF-921142–		(Eastern oil shale symposium; Lexington, KY (United States); 13-15 Nov 1992)			
8-Pt.2	18:25620	*See* UCRL-JC–110320-Pt.2			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-921145--		(Production and neutralization of negative ions and beams; Upton, NY (United States); 9-13 Nov 1992)			
8	18:27043	*See* BNL-49073			
CONF-921152--		(International gas research conference; Orlando, FL (United States); 16-19 Nov 1992)			
14	18:25981	*See* UCRL-JC-110675			
CONF-921201--		(37. annual conference on magnetism and magnetic materials; Houston, TX (United States); 1-4 Dec 1992)			
16	18:27905	*See* UCRL-JC-110945			
CONF-921203--		(Thermal performance of the exterior envelopes of buildings; Clearwater, FL (United States); 7-10 Dec 1992)			
12	18:27626	*See* LBL-31305			
CONF-921206--		(Materials Research Society (MRS) symposium; Boston, MA (United States); 2-6 Dec 1992)			
13	18:26777	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015300	MF-404
CONF-921214--		(7. international energy conference: world energy demand - is growth inevitable?; London (United Kingdom); 7-8 Dec 1992)			
1	18:26475	*See* ETDE-IT-93-153			
CONF-921256--		(1992 international conference on lasers; Houston, TX (United States); 7-11 Dec 1992)			
4	18:26728	*See* UCRL-JC-110669			
5	18:26958	*See* UCRL-JC-113290			
CONF-921266--		(Texas/PASCO '92 international conference; Berkeley, CA (United States); 13-18 Dec 1992)			
	18:27763	*See* WIS-PH-92-103			
2	18:27730	*See* UCRL-JC-113606			
CONF-921273--		(Workshop on electric utility systmes modeling; Las Cruces, NM (United States); 15-17 Dec 1992)			
	18:26398	OSTI; NTIS		DE93013924	
CONF-921274--		(Symposium on nuclear physics organized by Department of Atomic Energy (DAE); Bombay (India); 21-24 Dec 1992)			
1	18:27815	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012763	MF-413
CONF-921277--		(NATO advanced research workshop; Maderia (Portugal); Dec 1992)			
1	18:26856	*See* BNL-48966			
CONF-921281--		(Workshop on 3-dimensional graphics modeling of RFR distribution in humans; Brooks AFB, TX (United States); 8-9 Dec 1992)			
1	18:27633	*See* PNL-SA-21677			
CONF-921282--		(Conference on WWERs reactor safety; Paris (France); 9 Dec 1992)			
	18:26126	*See* CEA-DES-110			
CONF-930103--		(10. symposium on space nuclear power and propulsion; Albuquerque, NM (United States); 10-14 Jan 1993)			
32	18:26203	*See* BNL-48562			
34	18:26207	*See* LA-UR-93-1544			
35	18:26758	*See* LA-UR-93-1285			
36	18:26206	*See* BNL-48700			
37	18:26202	*See* BNL-48540			
38	18:26205	*See* BNL-48698			
40	18:26204	*See* BNL-48667			
CONF-9301102--		(American Nuclear Society (ANS) meeting; Clearwater, FL (United States); 27 Jan 1993)			
4	18:27375	*See* UCRL-JC-110401			
6	18:25675	*See* UCRL-JC-110276			
7	18:26265	*See* UCRL-JC-110425			
3-Rev.1	18:26385	*See* UCRL-JC-110275-Rev.1			
CONF-9301108--		(United States Geological workshop on future of energy gases; Palo Alto, CA (United States); 30-31 Jan 1993)			
1	18:25609	*See* DOE/METC/C-93/7064			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-9301109--		(2. international conference on physics and astrophysics of quark-gluon plasma; Calcutta (India); 19-23 Jan 1993)			
2	18:27769	*See* BNL--48876			
3	18:27722	*See* LBL--33771			
CONF-9301111--		(Colloquium in honor of Walter Mampe; Grenoble (France); 29 Jan 1993)			
1	18:27824	*See* LA-UR--93-1971			
CONF-930140--		(International specialty conference: the role of meteorology in managing the environment in the 1990s; Scottsdale, AZ (United States); 26-28 Jan 1993)			
4	18:27376	*See* UCRL-JC--111416			
CONF-930159--		(OE/LASE '93: International Society for Optical Engineering (SPIE) conference; Los Angeles, CA (United States); 16-23 Jan 1993)			
33	18:25911	*See* UCRL-JC--111091			
34	18:27929	*See* UCRL-JC--113163			
36	18:27885	*See* UCRL-JC--113498			
40	18:25910	*See* UCRL-JC--110875			
41	18:27224	*See* UCRL-JC--112671			
43	18:27884	*See* UCRL-JC--112624			
45	18:27895	*See* UCRL-JC--113277			
CONF-930160--		(2. semi-annual Office of Technology Development (OTD) information meeting; Houston, TX (United States); 26-28 Jan 1993)			
15	18:27475	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015445	MF-902; MF-901
CONF-930164--		(17. annual conference on composites and advanced ceramics; Cocoa Beach, FL (United States); 11-15 Jan 1993)			
11	18:26745	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015450	MF-332
12	18:26778	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015340	MF-332
CONF-930165--		(Water Federation Environment specialty conference on how clean is clean; Washington, DC (United States); 10-13 Jan 1993)			
3	18:27386	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015185	MF-902
CONF-930168--		(Simulating accelerator radiation environments workshop; Santa Fe, NM (United States); 11-15 Jan 1993)			
6	18:27871	*See* LA-UR--93-1216			
CONF-930169--		(16. nuclear physics symposium; Oaxtepec (Mexico); 5-8 Jan 1993)			
2	18:27037	*See* ANL/PHY/CP--79517			
CONF-930173--		(HIPAGS meeting; Cambridge, MA (United States); 14-17 Jan 1993)			
5	18:27831	*See* BNL--48694			
10	18:27833	*See* BNL--48888			
CONF-930187--		(13. Moriond workshop on perspectives in neutrinos, atomic physics, and gravitation; Villars-sur-Ollon (Switzerland); 30 Jan - 6 feb 1993)			
5	18:27793	*See* LA-UR--93-1970			
CONF-930197--		(9. winter workshop on nuclear dynamics; Key West, FL (United States); 30 Jan - 6 feb 1993)			
4	18:27858	*See* LBL--34008			
CONF-930202--		(Annual meeting of The Metallurgical Society; Denver, CO (United States); 21-25 Feb 1993)			
10	18:27931	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015306	MF-404; MF-310
CONF-930205--		(Waste management '93; Tucson, AZ (United States); 28 Feb - 4 mar 1993)			
1	18:25872	*See* PNL-SA--21891			
36	18:25869	*See* PNL-SA--21832			
40	18:25746	*See* PNL-SA--21716			
43	18:25873	*See* PNL-SA--21895			
47	18:25871	*See* PNL-SA--21879			
49	18:25747	*See* PNL-SA--21885			
51	18:25870	*See* PNL-SA--21870			
52	18:25874	*See* PNL-SA--21987			
57	18:25744	*See* PNL-SA--21455			

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60	18:25802	*See* WHC-SA–1810			
61	18:25676	*See* WHC-SA–1772			
63	18:25704	*See* EGG-M–92558			
65	18:25783	*See* WHC-SA–1423			
66	18:25805	*See* WHC-SA–1837			
67	18:25794	*See* WHC-SA–1701			
68	18:25793	*See* WHC-SA–1697			
69	18:25795	*See* WHC-SA–1708			
70	18:25792	*See* WHC-SA–1694			
71	18:25791	*See* WHC-SA–1671			
72	18:25790	*See* WHC-SA–1661			
78	18:25763	*See* UCRL-JC–113268			
CONF-9302103–		(Annual meeting of the Minerals, Metals and Materials Society (TMS); Denver, CO (United States); 22 Feb 1993)			
2	18:26703	*See* LA-UR–93-1142			
CONF-9302107–		(Application of synchrotron radiation and chemical dynamics workshop report; Oakland, CA (United States); 3-5 Feb 1993)			
Summ.	18:26877	*See* LBL–34131			
CONF-9302111–		(Powder metallurgy in aerospace, defense, and demanding applications; San Diego, CA (United States); 8-11 Feb 1993)			
1	18:26702	*See* LA-UR–93-712			
CONF-9302113–		(International conference on Monte Carlo simulation in nuclear and high energy physics; Tallahassee, FL (United States); 22-26 Feb 1993)			
1	18:27876	*See* LBL–33429			
CONF-9302114–		(International Gamma-ray Astrophysics Laboratory integral workshop; Les Diablerets (Switzerland); 2-5 Feb 1993)			
1	18:27701	*See* ANL/XFD/CP–79506			
CONF-9302115–		(AGU monograph/solar system plasma physics meeting on resolution of processes in space and time; Yosemite, CA (United States); Feb 1993)			
2	18:27709	*See* LA-UR–93-1159			
4	18:27720	*See* LA-UR–93-2371			
CONF-9302116–		(8. Optical Society of America (OSA) meeting on advanced solid-state lasers; New Orleans, LA (United States); 1-3 Feb 1993)			
1	18:26959	*See* UCRL-JC–113407			
2	18:26955	*See* UCRL-JC–111851			
CONF-9302121–		(American astronomical conference; Keystone, CO (United States); 6 Feb 1993)			
1	18:27243	*See* UCRL-JC–112250			
CONF-9302122–		(GOCO database meeting; Augusta, GA (United States); 2-3 Feb 1993)			
1	18:26386	*See* WINCO–11908			
CONF-9302124–		(1993 Cooling Tower Institute annual meeting; New Orleans, LA (United States); 17-19 Feb 1993)			
1	18:26973	*See* SLAC-PUB–6097			
CONF-930243–		(Data banks for risk assessment workshop; Augusta, GA (United States); 2-3 Feb 1993)			
7	18:26352	*See* EGG-M–93032			
CONF-930256–		(2. international plasma symposium on world progress in plasma applications; Palo Alto, CA (United States); 9-11 Feb 1993)			
1-Rev.1	18:26562	*See* UCRL-JC–112689-Rev.1			
CONF-930257–		(3. international symposium of field screening methods for hazardous wastes and toxic chemicals; Las Vegas, NV (United States); 24-26 Feb 1993)			
4	18:26835	*See* BNL–48580			
CONF-930269–		(Computational accelerator physics conference (CAP93); Pleasanton, CA (United States); 22-26 Feb 1993)			
14	18:27011	*See* LA-UR–93-1686			

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CONF-930274–		(Workshop on traps for antimatter and radioactive nuclei; Vancouver (Canada); 25-27 Feb 1993)			
2	18:27700	*See* UCRL-JC–113710			
CONF-930276–		(Department of Energy (DOE)/industry workshop on chemical safety; Germantown, MD (United States); 10-11 Feb 1993)			
Summ.	18:26420	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014702	MF-600
CONF-930281–		(6. transport task force workshop; Newport, RI (United States); 21-25 Feb 1993)			
7	18:27944	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013486	MF-427
CONF-930285–		(2. US/Japan workshop on global change research: environmental response technologies; Honolulu, HI (United States); 1-3 Feb 1993)			
1	18:27315	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013520	MF-402
CONF-930293–		(International symposium on 30 years of neutral currents; Los Angeles, CA (United States); 3-5 Feb 1993)			
2	18:26972	*See* LBL–33664			
3	18:27757	*See* LBL–33976			
CONF-930304–		(205. American Chemical Society national meeting; Denver, CO (United States); 28 Mar - 2 apr 1993)			
22	18:26824	*See* UCRL-JC–112379			
25	18:25904	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015438	MF-401
30	18:28067	*See* UCRL-JC–112361			
CONF-9303101–		(3. conference on computer generated forces and BR; Orlando, FL (United States); 17-19 Mar 1993)			
2	18:28199	*See* UCRL-JC–113106			
CONF-9303119–		(5. short wavelength: physics with intense laser pulses; San Diego, CA (United States); 29-31 Mar 1993)			
3	18:27928	*See* UCRL-JC–112630			
CONF-9303122–		(3. ARM science team meeting; Norman, OK (United States); 1-5 Mar 1993)			
5	18:27377	*See* UCRL-JC–113583			
CONF-9303123–		(5. international conference for the remediation of PCB contamination; Houston, TX (United States); 15-16 Mar 1993)			
1	18:26833	*See* ANL/ER/CP–77861			
CONF-9303126–		(4. international workshop on the physics of compressible turbulent mixing; Cambridge (United Kingdom); 29 Mar - 1 apr 1993)			
3	18:27906	*See* UCRL-JC–112287			
4	18:28070	*See* UCRL-JC–114505			
CONF-9303128–		(6. test technology symposium; Baltimore, MD (United States); 30 Mar 1993)			
2	18:27235	*See* LA-UR–93-1367			
CONF-930313–		(44. Pittsburgh conference and exposition on analytical chemistry and applied spectroscopy; Atlanta, GA (United States); 8-12 Mar 1993)			
2	18:25789	*See* WHC-SA–1637			
CONF-9303155–		(4. international inhalation symposium on toxic and carcinogenic effects of solid particles in the respiratory tract; Hanover (Germany); 1-5 Mar 1993)			
1	18:27649	*See* LA-UR–93-1165			
CONF-9303160–		(Workshop on neutrino telescopes; Venice (Italy); 2-4 Mar 1993)			
1	18:27806	*See* LA-UR–93-1348			
CONF-9303161–		(Critical issues in the development of high temperature structural materials meeting; Kona (Japan); 8-12 Mar 1993)			
1	18:26757	*See* LA-UR–93-1282			
CONF-9303162–		(International conference and workshop on applications of biotechnology to the minerals industry; Adelaide (Australia); 22-23 Mar 1993)			
1	18:25621	*See* EGG-M–93095			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-9303163–		(American Defense Preparedness Association course; Ft. Walton Beach, FL (United States); 22-26 Mar 1993)			
1	18:27237	*See* PNL-SA–22163			
CONF-9303165–		(Advanced technology program proposal meeting; Arlington, TX (United States); 19 Mar 1993)			
1	18:26529	*See* KCP–613-5172			
CONF-9303166–		(1993 South Carolina environmental conference; Hilton Head, SC (United States); 30 Mar 1993)			
1	18:25820	*See* WSRC-MS–93-184			
CONF-9303168–		(1993 regional hazardous wastes and materials conference; Pacatello, ID (United States); 29-31 Mar 1993)			
1	18:27659	*See* EGG-M–93017			
CONF-9303169–		(Israel Geological Society annual meeting; Arad (Israel); 15 Mar 1993)			
	18:27425	*See* INIS-mf–13541			
CONF-930317–		(Conference on critical issues in the development of high temperature structural materials; Kona, HI (United States); 7-12 Mar 1993)			
1	18:26812	*See* PNL-SA–21693			
CONF-9303171–		(28. Recontres de Moriond conference on electroweak interaction and unified theories; Les Arcs (France); 13-20 Mar 1993)			
2	18:27795	*See* LBL–33952			
CONF-9303172–		(1993 Recontres de Physique de La Vallee D'Aoste; LaThuile (Italy); 8-13 Mar 1993)			
1	18:27796	*See* LBL–34077			
CONF-9303178–		(24. annual Appalachian petroleum geology symposium: innovative concepts in reservoir characterization; Morgantown, WV (United States); 29-31 Mar 1993)			
1	18:25591	*See* DOE/METC/C–93/7085			
CONF-930318–		(NACE annual corrosion conference and materials performance and corrosion show; New Orleans, LA (United States); 7-12 Mar 1993)			
10	18:26779	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93015462	MF-1004
CONF-9303181–		(Society for Applied Anthropology meeting; San Antonio, TX (United States); 10-14 Mar 1993)			
1	18:26414	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015483	
CONF-9303182–		(Applied Computational Electromagnetic Society (ACES) meeting; Monterey, CA (United States); 24 Mar 1993)			
1	18:27652	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015463	MF-220
CONF-9303189–		(Requiem for an accelerator conference; Daresbury (United Kingdom); 13-14 Mar 1993)			
1	18:27816	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015805	MF-413
CONF-9303194–		(Meeting on Protection, Handling, Detection and Safety; Strasbourg (France); 30 Mar - 1 apr 1993)			
	18:27604	*See* CEA-CONF–11308			
CONF-930323–		(19. environmental vision 2000: DOE/EPA/USCG - can current technology and resources get us there; Albuquerque, NM (United States); 23-27 Mar 1993)			
2	18:25749	*See* PNL-SA–22089			
CONF-930331–		(6. Society for Industrial and Applied Mathematics (SIAM) conference on parallel processing for scientific computing; Norfolk, VA (United States); 21-24 Mar 1993)			
11	18:28169	*See* LA-UR–93-1565			
CONF-930332–		(Optical Society of America integrated photonics research topical meeting; Palm Springs, CA (United States); 22-25 Mar 1993)			
1	18:26957	*See* UCRL-JC–112217			

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CONF-930347–		(7. annual conference on clean and efficient combustion of fossil fuels and toxic wastes; Park City, UT (United States); 2-5 Mar 1993)			
1	18:25524	*See* DOE/METC/C–93/7066			
CONF-930363–		(28. conference on quantum chromodynamics and high energy hadronic interactions; Les Arcs (France); 20-27 Mar 1993)			
1	18:27792	*See* LA-UR–93-1969			
3	18:27781	*See* FNAL/C–93/146-E			
CONF-930364–		(Spring national meeting of the American Institute of Chemical Engineers; Houston, TX (United States); 28 Mar - 1 apr 1993)			
4	18:26857	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014705	MF-231
CONF-930367–		(Conference on spectroscopies in novel superconductors; Santa Fe, NM (United States); 17-19 Mar 1993)			
3	18:27932	*See* LA-UR–93-1384			
5	18:26763	*See* LBL–33971			
6	18:27930	*See* ANL/MSD/CP–79586			
CONF-930389–		(Future directions in particle and nuclear physics at multi-GeV hadron beam facilities; Upton, NY (United States); 4-6 Mar 1993)			
4	18:27790	*See* LA-UR–93-1292			
9	18:26968	*See* LA-UR–93-1387			
12	18:27767	*See* BNL–48832			
13	18:27857	*See* LA-UR–93-1692			
14	18:27791	*See* LA-UR–93-1965			
15	18:27801	*See* BNL–48865			
16	18:27812	*See* BNL–48886			
17	18:27811	*See* BNL–48879			
21	18:27794	*See* LA-UR–93-2021			
CONF-930392–		(1993 joint Central States and Eastern sections of the Combustion Institute; New Orleans, LA (United States); 15-17 Mar 1993)			
2	18:26885	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014275	MF-404
CONF-930397–		(Numerical modeling for underground nuclear test monitoring symposium; Durango, CO (United States); 23-25 Mar 1993)			
2	18:27260	*See* LA-UR–93-1615			
3	18:27261	*See* LA-UR–93-1699			
CONF-930401–		(Meeting on nuclear plant instrumentation, control and man-machine interface technologies; Oak Ridge, TN (United States); 18-21 Apr 1993)			
15	18:26253	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93010262	
17	18:26344	*See* BNL-NUREG–48657			
18	18:26092	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015326	MF-406
CONF-930403–		(5. topical meeting on robotics and remote systems; Knoxville, TN (United States); 26-29 Apr 1993)			
52	18:25812	*See* WINCO–11916			
CONF-930405–		(Spring meeting of the Materials Research Society; San Francisco, CA (United States); 12-16 Apr 1993)			
3	18:26875	*See* ANL/CHM/CP–79508			
7	18:26716	*See* SAND–92-2508C			
8	18:26718	*See* SAND–93-1013C			
10	18:26709	*See* LBL–33948			
11	18:27171	*See* BNL–48960			
12	18:26836	*See* BNL–48887			
13	18:26574	*See* BNL–48953			
14	18:26575	*See* BNL–48954			
15	18:26807	*See* LA-UR–93-1927			
16	18:26834	*See* ANL/MSD/CP–78019			
18	18:26569	*See* ANL/XFD/CP–79634			
20	18:26873	*See* PNL–SA-22038			
21	18:26792	*See* EGG–10617-2186			
22	18:27181	*See* EGG–10617-2182			
25	18:26595	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015430	MF-404

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-930408--		(International high-level radioactive waste management conference; Las Vegas, NV (United States); 25-29 Apr 1993)			
57	18:25680	*See* ANL/EAIS/CP--78643			
59	18:25729	*See* LBL--33597			
67	18:25797	*See* WHC-SA--1735			
73	18:27458	*See* SAND--92-2795C			
78	18:25653	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015296	MF-940
80	18:25796	*See* WHC-SA--1729			
CONF-9304109--		(SAGEEP '93: symposium on the application of geophysics to environmental and engineering problems; San Diego, CA (United States); 18-21 Apr 1993)			
2	18:27382	*See* ANL/ES/CP--77816			
4	18:25877	*See* SAND--92-2296C			
CONF-9304112--		(10. topical conference on radio frequency power in plasmas; Boston, MA (United States); 1-3 Apr 1993)			
10	18:27945	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012965	MF-420
11	18:27990	*See* GA-A--21257			
13	18:28033	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013274	MF-420
14	18:27991	*See* GA-A--21292			
16	18:28023	*See* PPPL--2913			
17	18:28034	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015441	MF-420
CONF-9304122--		(Meson interferometry in relativistic heavy ion collisions; Upton, NY (United States); 16-17 Apr 1993)			
	18:27832	*See* BNL--48880			
CONF-9304123--		(8. Korean Atomic Industrial Forum/Korean Nuclear Society/OKAEA annual conference; Seoul (Korea, Republic of); 20-21 Apr 1993)			
1	18:26342	*See* BNL--48697			
CONF-9304126--		(3. international conference on dense z-pinches; London (United Kingdom); 19-23 Apr 1993)			
5	18:28005	*See* LA-UR--93-1318			
CONF-9304128--		(Department of Energy (DOE) radiation protection conference; Las Vegas, NV (United States); 13-15 Apr 1993)			
2	18:27609	*See* EGG-M--93073			
3	18:25851	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012962	MF-407
12	18:26853	*See* PNL-SA--22007			
CONF-9304131--		(Advanced Monte Carlo computer programs for radiation transport; Saclay (France); 27-29 Apr 1993)			
3	18:27872	*See* LA-UR--93-1446			
5	18:27877	*See* SAND--93-0482C			
6	18:27878	*See* SAND--93-1010C			
7	18:27866	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015205	MF-600
CONF-9304133--		(Annual conference and exhibition of the Society of Tribologists and Lubrication Engineers; Calgary (Canada); 17-20 Apr 1993)			
1	18:26735	*See* ANL/MCT/CP--77789			
CONF-9304134--		(1993 National Department of Energy (DOE)/contractors and facilities data acquisition and control user's group meeting; Livermore, CA (United States); 13-16 Apr 1993)			
1	18:28080	*See* EGG-M--93143			
CONF-9304135--		(1. European conference on space debris; Darmstadt (Germany); 5-8 Apr 1993)			
1	18:26932	*See* SAND--92-2460C			
2	18:26931	*See* SAND--92-2090C			
CONF-9304136--		(MRS symposium on thin films, stresses and mechanical properties; Pittsburgh, PA (United States); 12-16 Apr 1993)			
1	18:26705	*See* LA-UR--93-1201			
CONF-9304137--		(Centre d'Etudes meeting; Saclay (France); 27-29 Apr 1993)			
1	18:27873	*See* LA-UR--93-1475			

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CONF-9304138–		(Principles of cutting mechanics; Tucson, AZ (United States); 13-15 Apr 1993)			
1	18:26704	*See* LA-UR–93-1150			
CONF-9304141–		(2. international cancer chemo prevention conference; Berlin (Germany); 28-30 Apr 1993)			
1	18:27602	*See* ANL/BIM/CP–78742			
CONF-9304142–		(4. space electrochemical research and technology conference; Cleveland, OH (United States); 14-15 Apr 1993)			
1	18:26483	*See* LA-UR–93-1305			
CONF-9304143–		(Occupational ergonomic annual symposium; Lubbock, TX (United States); 16-17 Apr 1993)			
1	18:27660	*See* EGG-M–93090			
CONF-9304144–		(2. international conference on laser ablation; Knoxville, TN (United States); 19-22 Apr 1993)			
1	18:26827	*See* UCRL-JC–112981			
2	18:27476	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015426	MF-402
3	18:26780	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015436	MF-401
4	18:26747	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015797	MF-404; MF-410
9	18:25748	*See* PNL-SA–22070			
CONF-9304145–		(International workshop on low energy muon science (LEMS '93); Santa Fe, NM (United States); 4-8 Apr 1993)			
2	18:27933	*See* LA-UR–93-1736			
CONF-9304146–		(Alloy 600 experts meeting; Warrenton, VA (United States); 5-9 Apr 1993)			
1	18:26715	*See* PNL-SA–22257			
CONF-9304147–		(INTERCHI '93: interact and computation human interaction; Amsterdam (Netherlands); 24-29 Apr 1993)			
1	18:28197	*See* UCRL-JC–112195			
CONF-9304148–		(Department of Energy Monte Carlo workshop; Irving, CA (United States); 28-29 Apr 1993)			
1	18:27926	*See* PNL-SA–22200			
CONF-9304149–		(36. annual Society of Vacuum Coaters technical conference; Dallas, TX (United States); 27-29 Apr 1993)			
1	18:26025	*See* NREL/TP–471-5536			
CONF-9304150–		(8. conference on microscopy of semiconducting materials; Oxford (United Kingdom); 5-8 Apr 1993)			
1	18:26946	*See* LBL–33886			
CONF-9304152–		(From spectroscopy to chaos; Rochester, NY (United States); 17 Apr 1993)			
1	18:27697	*See* LA-UR–93-1824			
CONF-9304154–		(Interface computing science and statistics; San Diego, CA (United States); 14-17 Apr 1993)			
1	18:26239	*See* LA-UR–93-1980			
CONF-9304161–		(Northwest Regional Economic conference; Kennewick, WA (United States); 30 Apr 1993)			
1	18:27505	*See* PNL-SA–22622			
CONF-9304173–		(Energy management and environment; Pilzen (Czech Republic); 20 Apr 1993)			
	18:25617	*See* INIS-mf–13564			
CONF-930419–		(International conference on metallurgical coatings and thin films; San Diego, CA (United States); 19-23 Apr 1993)			
2	18:27180	*See* EGG–10617-2168			
CONF-930438–		(95. annual meeting of the American Ceramic Society; Cincinnati, OH (United States); 18-22 Apr 1993)			
6	18:26760	*See* LA-UR–93-1456			
8	18:25823	*See* WSRC-MS–93-222			
9	18:26759	*See* LA-UR–93-1306			
1-Rev.1	18:25817	*See* WSRC-MS–92-503-Rev.1			
10	18:25679	*See* ANL/CMT/CP–78025			
13	18:25822	*See* WSRC-MS–93-215			
14	18:26803	*See* LA-UR–93-1322			
16	18:25750	*See* PNL-SA–22322			

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19	18:25816	*See* WSRC-MS–92-485			
21	18:26771	*See* ANL/MCT/CP–78063			
23	18:26770	*See* SAND–93-1068C			
24	18:26746	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015801	MF-332
Rev.1	18:25818	*See* WSRC-MS–93-002-Rev.1			
CONF-930445–		(Society of Photo-Optical Instrumentation Engineers (SPIE) OE/aerospace science and sensing meeting; Orlando, FL (United States); 11-16 Apr 1993)			
14	18:27228	*See* SAND–92-2210C			
18	18:27225	*See* UCRL-JC–113273			
CONF-930475–		(Innovative concepts technology fair; Austin, TX (United States); 22-23 Apr 1993)			
1	18:25681	*See* BNL–48991			
CONF-930483–		(9. waste minimization and pollution prevention conference; San Francisco, CA (United States); 13-15 Apr 1993)			
1	18:25720	*See* KCP–613-5137			
7	18:26528	*See* KCP–613-5138			
8	18:26436	*See* SAND–93-0466C			
9	18:27463	*See* UCRL-JC–113510			
10	18:27387	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016234	MF-902
11	18:26541	*See* WHC-SA–1904			
CONF-930484–		(Geothermal program review; Berkeley, CA (United States); 27-29 Apr 1993)			
2	18:26476	*See* LA-UR–93-1991			
6	18:26048	*See* SAND–93-1271C			
CONF-930488–		(10. symposium on training of nuclear facility personnel; Nashville, TN (United States); 25-29 Apr 1993)			
1	18:26419	*See* ANL/ESH/CP–78719			
CONF-930495–		(DOE/NARUC national conference on natural gas use: state regulation and market dynamics in the post-636/Energy Policy Act, Era; New Orleans, LA (United States); 26-28 Apr 1993)			
1	18:25618	*See* ANL/EAIS/CP–79499			
CONF-9305100–		(3. international symposium on solid oxide fuel cells; Honolulu, HI (United States); 16-21 May 1993)			
2	18:26496	*See* PNL-SA–21621			
CONF-9305101–		(3. international symposium on carbonate fuel cell technology; Honolulu, HI (United States); 16-21 May 1993)			
1	18:26480	*See* DOE/MC/27168–93/C0189			
3	18:26482	*See* DOE/METC/C–93/7083			
CONF-930511–		(International particle accelerator conference; Washington, DC (United States); 17-20 May 1993)			
4	18:26962	*See* ANL/EP/CP–79507			
7	18:27064	*See* KCP–613-5221			
8	18:27152	*See* UCRL-JC–114215			
100	18:27080	*See* LA-UR–93-1881			
101	18:27066	*See* LA-UR–93-1737			
102	18:27069	*See* LA-UR–93-1782			
103	18:27068	*See* LA-UR–93-1778			
104	18:27199	*See* LA-UR–93-1715			
105	18:27070	*See* LA-UR–93-1821			
106	18:27072	*See* LA-UR–93-1828			
107	18:27075	*See* LA-UR–93-1848			
108	18:27024	*See* SSCL-Preprint–372			
110	18:25915	*See* LA-UR–93-1716			
111	18:27163	*See* LA-UR–93-1868			
112	18:27164	*See* LA-UR–93-1874			
113	18:25917	*See* LA-UR–93-1897			
114	18:27165	*See* LA-UR–93-1921			
115	18:27076	*See* LA-UR–93-1853			
116	18:25916	*See* LA-UR–93-1878			
117	18:27099	*See* SLAC-PUB–6152			
118	18:27137	*See* SSCL-Preprint–359			
120	18:27127	*See* SSCL-Preprint–312			

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121	18:27134	*See* SSCL-Preprint–352			
124	18:26988	*See* BNL–48374			
125	18:26985	*See* BNL–48239			
126	18:27040	*See* BNL–48236			
127	18:26982	*See* BNL–48233			
128	18:27039	*See* BNL–48208			
129	18:27886	*See* BNL–48218			
130	18:27144	*See* SSCL-Preprint–383			
131	18:27022	*See* SSCL-Preprint–368			
132	18:27031	*See* ANL/ASD/CP–78167			
133	18:27168	*See* UCRL-JC–112334			
134	18:27034	*See* ANL/ASD/CP–78347			
135	18:27001	*See* FNAL/C–93/126			
137	18:27032	*See* ANL/ASD/CP–78290			
138	18:27053	*See* FNAL/C–93/118			
139	18:26966	*See* FNAL/C–93/123			
14	18:27209	*See* SSCL-Preprint–293			
140	18:27000	*See* FNAL/C–93/119			
141	18:27052	*See* FNAL/C–93/113			
142	18:27051	*See* FNAL/C–93/110			
145	18:27036	*See* ANL/ASD/CP–78371			
146	18:27035	*See* ANL/ASD/CP–78370			
147	18:26980	*See* ANL/ASD/CP–78288			
148	18:26981	*See* ANL/ASD/CP–78298			
149	18:27033	*See* ANL/ASD/CP–78299			
150	18:27154	*See* BNL–48271			
151	18:27153	*See* BNL–48217			
152	18:26987	*See* BNL–48373			
155	18:26990	*See* BNL–48386			
156	18:27262	*See* ANL/EP/CP–79689			
157	18:27166	*See* LBL–33307			
158	18:27016	*See* SAND–93-7067C			
159	18:26986	*See* BNL–48240			
160	18:26963	*See* BNL–48220			
162	18:27002	*See* FNAL/C–93/130			
163	18:27094	*See* SLAC-PUB–6130			
164	18:27017	*See* SLAC-PUB–6123			
165	18:27095	*See* SLAC-PUB–6131			
166	18:27098	*See* SLAC-PUB–6142			
167	18:27042	*See* BNL–48272			
170	18:27028	*See* SSCL-Preprint–411			
171	18:27026	*See* SSCL-Preprint–399			
180	18:27147	*See* SSCL-Preprint–414			
182	18:27029	*See* SSCL-Preprint–412			
183	18:27146	*See* SSCL-Preprint–400			
184	18:27145	*See* SSCL-Preprint–398			
186	18:27027	*See* SSCL-Preprint–409			
202	18:27025	*See* SSCL-Preprint–391			
204	18:27133	*See* SSCL-Preprint–350			
205	18:27128	*See* SSCL-Preprint–328			
206	18:26979	*See* SSCL-Preprint–428			
209	18:27003	*See* FNAL/C–93/135			
211	18:26970	*See* LA-UR–93-2090			
213	18:28068	*See* UCRL-JC–112378			
214	18:27151	*See* UCRL-JC–112343			
27	18:27021	*See* SSCL-Preprint–367			
28	18:27119	*See* SSCL-Preprint–278			
31	18:27140	*See* SSCL-Preprint–364			
32	18:27020	*See* SSCL-Preprint–238			
35	18:26978	*See* SSCL-Preprint–370			
37	18:27086	*See* LA-UR–93-1955			
38	18:27136	*See* SSCL-Preprint–357			
39	18:27139	*See* SSCL-Preprint–362			
40	18:27135	*See* SSCL-Preprint–354			
42	18:26969	*See* LA-UR–93-1879			
43	18:27081	*See* LA-UR–93-1893			
45	18:27087	*See* LA-UR–93-2038			
46	18:27077	*See* LA-UR–93-1867			
48	18:27079	*See* LA-UR–93-1880			
49	18:27013	*See* LA-UR–93-1919			
50	18:27875	*See* LA-UR–93-1925			

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51	18:27083	*See* LA-UR–93-1912			
52	18:27874	*See* LA-UR–93-1922			
53	18:27109	*See* SSCL-Preprint–242			
54-Rev.2	18:27019	*See* SSCL-Preprint–149-Rev.2			
56	18:26974	*See* SSCL-Preprint–207			
57	18:27138	*See* SSCL-Preprint–360			
58	18:27141	*See* SSCL-Preprint–374			
59	18:27143	*See* SSCL-Preprint–381			
60	18:27142	*See* SSCL-Preprint–380			
61	18:27129	*See* SSCL-Preprint–329			
65	18:27131	*See* SSCL-Preprint–347			
69	18:28066	*See* UCRL-JC–112341			
70	18:27041	*See* BNL–48260			
72	18:26989	*See* BNL–48375			
73	18:26991	*See* BNL–48388			
74	18:26983	*See* BNL–48235			
75	18:26984	*See* BNL–48237			
81	18:27067	*See* LA-UR–93-1743			
82	18:27012	*See* LA-UR–93-1816			
87	18:26961	*See* LA-UR–93-1704			
89	18:27125	*See* SSCL-Preprint–300			
90	18:27123	*See* SSCL-Preprint–288			
92	18:27084	*See* LA-UR–93-1924			
93	18:27078	*See* LA-UR–93-1871			
95	18:28140	*See* DOE/ER/40374–70			
96	18:27073	*See* LA-UR–93-1833			
97	18:27074	*See* LA-UR–93-1847			
98	18:27071	*See* LA-UR–93-1827			
99	18:27082	*See* LA-UR–93-1910			
CONF-9305110–		(Expo 93; Oak Ridge, TN (United States); May 1993)			
3	18:25897	*See* SAND–92-2782C			
CONF-9305134–		(11. symposium on energy engineering sciences; Argonne, IL (United States); 3-5 May 1993)			
1	18:27903	*See* LA-UR–93-1755			
CONF-9305135–		(7. annual conference on fossil energy materials; Oak Ridge, TN (United States); 11-13 May 1993)			
4	18:26596	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015800	MF-114
5	18:26597	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015820	MF-114
CONF-9305136–		(International symposium on heavy ion fusion; Frascati (Italy); 25-28 May 1993)			
1	18:28030	*See* BNL–48642			
2	18:28060	*See* SAND–93-1289C			
4	18:28069	*See* UCRL-JC–113282			
CONF-9305151–		(15. computer security group training conference: mission possible - connected and protected; Albuquerque, NM (United States); 3-6 May 1993)			
3	18:28167	*See* LA-UR–93-1181			
CONF-9305161–		(INGRES world '93 conference; Santa Clara, CA (United States); 9-13 May 1993)			
2	18:28214	*See* SAND–93-0869C			
CONF-9305166–		(American Filtration Society seminar and expo annual meeting; Chicago, IL (United States); 3-6 May 1993)			
2	18:25613	*See* DOE/METC/C–93/7068			
CONF-9305168–		(Application Visualization System (AVS) '93 users group meeting; Orlando, FL (United States); 24-26 May 1993)			
3	18:28188	*See* SAND–93-1002C			
CONF-9305177–		(12. International collaboration of advanced neutron sources meeting (ICANS); Abingdon (United Kingdom); 24-28 May 1993)			
4	18:27201	*See* LA-UR–93-1752			
5	18:26806	*See* LA-UR–93-1711			
CONF-9305179–		(2. specialists conference and short course on thermionic energy conversion; Goteborg (Sweden); 3-7 May 1993)			
1	18:26384	*See* SAND–93-1067C			

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CONF-9305184–		(48. annual industrial waste conference; West Lafayette, IN (United States); 10-12 May 1993)			
1	18:27506	*See* RFP–4677			
CONF-9305185–		(American Chemical Society meeting on rubber chemistry and technology; Denver, CO (United States); 18-22 May 1993)			
1	18:26804	*See* LA-UR–93-1657			
CONF-9305187–		(Ideas in science and electronics; Albuquerque, NM (United States); 11 May 1993)			
1	18:26555	*See* SAND–92-2903C			
2	18:26901	*See* LA-UR–93-1717			
3	18:27367	*See* SAND–93-1031C			
CONF-9305189–		(1993 joint Army, Navy, NASA, Air Force (JANNAF) Propulsion Systems Hazards Subcommittee meeting; Ft. Lewis, WA (United States); 10-14 May 1993)			
3	18:26890	*See* SAND–93-1069C			
CONF-9305190–		(SSAC conference; Santa Fe, NM (United States); 10-14 May 1993)			
1	18:25891	*See* LA-UR–93-1304			
CONF-9305193–		(2. EG&G GOCO environmental conference; Idaho Falls, ID (United States); 12-14 May 1993)			
1	18:25876	*See* RFP–4723			
CONF-9305195–		(1993 Spring meeting of the Materials Research Society (MRS); San Francisco, CA (United States); 12-16 May 1993)			
1	18:26769	*See* SAND–92-2490C			
CONF-9305199–		(Gravity and relativistic astrophysics; Waterloo (Canada); 13-15 May 1993)			
1	18:27717	*See* LA-UR–93-1732			
CONF-9305203–		(International school seminar on heavy ion physics; Dubna (Russian Federation); 10-15 May 1993)			
1	18:27830	*See* ANL/PHY/CP–79497			
CONF-9305207–		(2. international conference on information and knowledge management; Washington, DC (United States); 1-5 May 1993)			
1	18:28133	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015442	MF-406
CONF-9305210–		(9. International Atomic Energy Agency (IAEA) workshop on stellarators; Garching (Germany); 10-14 May 1993)			
1	18:28053	*See* GA-A–21281			
CONF-9305215–		(IAEA specialists meeting on experience in ageing, maintenance and modernization of instrumentation and control systems for improving nuclear power plant availability; Rockville, MD (United States); 5-7 May 1993)			
1	18:26254	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015434	
CONF-9305216–		(1. European workshop on beam instrumentation and diagnostics for particle accelerators; Montreux (Switzerland); 3-5 May 1993)			
1	18:27096	*See* SLAC-PUB–6134			
CONF-9305218–		(2. international engineering research conference; Los Angeles, CA (United States); 23-26 May 1993)			
1	18:28183	*See* PNL-SA–21610			
CONF-9305219–		(Global change research: science and policy meeting; Washington, DC (United States); 17 May 1993)			
1	18:27365	*See* PNL-SA–22390			
CONF-9305229–		(National Toxicology Program; Triangle Park, NC (United States); 23-25 May 1993)			
1	18:27646	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015813	MF-407
CONF-930523–		(18. National Association of Environmental Professionals (NAEP) annual conference on current and future priorities for environmental management; Raleigh, NC (United States); 24-26 May 1993)			
8	18:25692	*See* DOE/METC/C–93/7063			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-9305231–		(International Atomic Energy Agency (IAEA) technical committee meeting; Trieste (Italy); 10-14 May 1993)			
1	18:27946	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016235	MF-421
CONF-9305237–		(Annual meeting of the North American Benthol Society; Calgary (Canada); 25-28 May 1993)			
1	18:27504	*See* PNL-SA–22329			
CONF-930533–		(15. annual symposium of the European Safeguards Research and Development Association: safeguards and nuclear materials management; Rome (Italy); 11-13 May 1993)			
2	18:27198	*See* LA-UR–93-1640			
4	18:28094	*See* BNL–48968			
5	18:25894	*See* LA-UR–93-1728			
7	18:25893	*See* LA-UR–93-1669			
8	18:27200	*See* LA-UR–93-1727			
CONF-930537–		(5. annual international industrial symposium on the Super Collider and exhibition; San Francisco, CA (United States); 6-8 May 1993)			
9	18:26975	*See* SSCL-Preprint–217			
12	18:26976	*See* SSCL-Preprint–253			
15	18:27110	*See* SSCL-Preprint–246			
16	18:27670	*See* SSCL-Preprint–209			
18	18:27121	*See* SSCL-Preprint–284			
26	18:27103	*See* SSCL-Preprint–222			
27	18:27101	*See* SSCL-Preprint–214			
28	18:27105	*See* SSCL-Preprint–232			
29	18:27208	*See* SSCL-Preprint–211			
30	18:27106	*See* SSCL-Preprint–233			
31	18:27116	*See* SSCL-Preprint–268			
32	18:27115	*See* SSCL-Preprint–266			
33	18:27108	*See* SSCL-Preprint–236			
35	18:27102	*See* SSCL-Preprint–218			
37	18:27111	*See* SSCL-Preprint–247			
38	18:27104	*See* SSCL-Preprint–224			
39	18:27113	*See* SSCL-Preprint–251			
40	18:27118	*See* SSCL-Preprint–275			
41	18:27112	*See* SSCL-Preprint–248			
42	18:27114	*See* SSCL-Preprint–257			
44	18:27100	*See* SSCL-Preprint–213			
45	18:27023	*See* SSCL-Preprint–369			
47	18:27117	*See* SSCL-Preprint–271			
48	18:27126	*See* SSCL-Preprint–308			
49	18:27120	*See* SSCL-Preprint–281			
50	18:27107	*See* SSCL-Preprint–234			
51	18:27122	*See* SSCL-Preprint–285			
52	18:27088	*See* LBL–34052			
55	18:27050	*See* FNAL/C–93/108			
58	18:27132	*See* SSCL-Preprint–348			
59	18:27130	*See* SSCL-Preprint–337			
72	18:27124	*See* SSCL-Preprint–289			
CONF-930538–		(4. conduct of operations workshop: the key to continued success; Tampa, FL (United States); 4-6 May 1993)			
1	18:25803	*See* WHC-SA–1813			
2	18:26329	*See* WHC-SA–1934			
CONF-930540–		(23. Institute of Electrical and Electronics Engineers (IEEE) photovoltaic specialists conference; Louisville, KY (United States); 10-14 May 1993)			
2	18:26006	*See* SAND–92-2829C			
3	18:26001	*See* SAND–92-2872C			
6	18:26813	*See* SAND–92-2867C			
8	18:26027	*See* SAND–92-2831C			
CONF-930557–		(Conference on physics computing; Albuquerque, NM (United States); 31 May - 4 jun 1993)			
1	18:27459	*See* SAND–93-0100C			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-930561–		(39. international instrumentation symposium; Albuquerque, NM (United States); 2-6 May 1993)			
5	18:27403	*See* EGG-M–92586			
6	18:26026	*See* SAND–92-2789C			
CONF-930570–		(2. annual Federal environmental restoration conference and exhibition; Washington, DC (United States); 25-27 May 1993)			
1	18:26421	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015424	MF-602
2	18:27388	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015435	MF-902
3	18:26537	*See* PNL-SA–22461			
CONF-930571–		(183. Electrochemical Society meeting; Honolulu, HI (United States); 16-21 May 1993)			
13	18:26479	*See* DOE/MC/27168–93/C0188			
18	18:26852	*See* PNL-SA–21721			
21	18:26826	*See* UCRL-JC–112521			
25	18:27457	*See* PNL-SA–21614			
CONF-930572–		(12. annual international symposium on thermal treatment technologies - incineration conference; Knoxville, TN (United States); 3-7 May 1993)			
3	18:26867	*See* LA-UR–93-1527			
5	18:25807	*See* WHC-SA–1866			
6	18:25762	*See* UCRL-JC–112711			
CONF-930580–		(12. Royal Aeronautical Society/American Institute of Aeronautics and Astronautics (RAS/AIAA) aerodynamic decelerator systems technical conference; London (United Kingdom); 10 May 1993)			
3	18:27239	*See* SAND–92-1888C			
CONF-930588–		(9. optical fiber sensors conference; Firenze (Italy); 4-6 May 1993)			
2	18:27219	*See* LA-UR–93-1449			
CONF-930594–		(9. international conference on high power particle beams; Washington, DC (United States); 25-29 May 1993)			
1	18:28063	*See* UCRL-JC–108854			
CONF-930601–		(American Nuclear Society (ANS) annual meeting; San Diego, CA (United States); 20-24 Jun 1993)			
18-Rev.1	18:25884	*See* WSRC-MS–92-477-Rev.1			
19	18:26333	*See* WSRC-MS–93-287			
20	18:26251	*See* BNL-NUREG–48658			
21	18:26566	*See* WINCO–11907			
CONF-9306100–		(Zeolite 93: 4th international conference on the occurrence, properties, and utilization of natural zeolites; Boise, ID (United States); 20-28 Jun 1993)			
2	18:27430	*See* LA-UR–93-2326			
CONF-9306113–		(17. solar photochemistry research conference; Brainerd, MN (United States); 6-10 Jun 1993)			
1	18:25995	*See* ANL/CHM/CP–79459			
CONF-9306125–		(6. international conference on multiphoton processes; Quebec City (Canada); 25-30 Jun 1993)			
2	18:27894	*See* K/ETO–127			
CONF-9306143–		(Energy Facility Contractors Group safety analysis meeting; Denver, CO (United States); 16-18 Jun 1993)			
4	18:25878	*See* SAND–93-0463C			
7	18:27635	*See* RFP–4713			
9	18:26905	*See* RFP–4704			
12	18:25651	*See* WHC-SA–1812			
13	18:25882	*See* WHC-SA–1831			
14	18:25806	*See* WHC-SA–1846			
Summ.	18:25875	*See* RFP–4714			
CONF-9306155–		(Symposium on theory of computation (STOC); San Diego, CA (United States); 7-11 Jun 1993)			
1	18:28170	*See* LA-UR–93-1569			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-9306156–		(Records management conference: ARMA material; Seattle, WA (United States); 14-17 Jun 1993)			
1	18:25881	*See* WHC-SA–1706			
CONF-9306158–		(1993 groundwater modeling conference; Boulder, CO (United States); 6-12 Jun 1993)			
1	18:27465	*See* WSRC-MS–93-201			
CONF-9306159–		(1993 Society of Women Engineers (SWE) conference; Chicago, IL (United States); 21-27 Jun 1993)			
2	18:27381	*See* ANL/ER/CP–79580			
CONF-930616–		(9. IEEE pulsed power conference; Albuquerque, NM (United States); 21-23 Jun 1993)			
2	18:26949	*See* SAND–93-1280C			
5	18:28055	*See* LA-UR–93-2354			
CONF-9306161–		(8. annual conference on computer assurance; Gaithersburg, MD (United States); 14-17 Jun 1993)			
1	18:27655	*See* ANL/EAIS/CP–79460			
CONF-9306162–		(ACM SIGPLAN symposium on partial evaluation and semantics based program manipulation; Gothenburg (Sweden); 14-16 Jun 1993)			
1	18:28093	*See* ANL/MCS/CP–78726			
CONF-9306163–		(Items '93: an imaging technology conference and exposition; Washington, DC (United States); 6-10 Jun 1993)			
1	18:27227	*See* LA-UR–93-1523			
CONF-9306167–		(14. international conference on high pressure science and technology and 1993 technical meeting of the topical group on shock compression of condensed matter; Colorado Springs, CO (United States); 28 Jun - 3 jul 1993)			
1	18:27719	*See* LA-UR–93-1968			
2	18:26805	*See* LA-UR–93-1710			
3	18:26707	*See* LA-UR–93-1785			
5	18:26708	*See* LA-UR–93-2323			
8	18:27230	*See* SAND–93-0370C			
CONF-9306168–		(3. international symposium on the history of particle physics: the rise of the standard model; Stanford, CA (United States); 24-27 Jun 1993)			
1	18:27768	*See* BNL–48871			
CONF-9306170–		(17. transducer workshop; San Diego, CA (United States); 22-24 Jun 1993)			
1	18:26933	*See* SAND–92-2712C			
CONF-9306172–		(15. combustion research contractors' meeting; Lake Harmony, PA (United States); 2-4 Jun 1993)			
	18:26884	*See* BNL–48923			
1	18:26871	*See* LBL–33919-ABS			
CONF-9306174–		(European Council for an energy-efficient economy summer study; Rungstedgaard (Denmark); 1-5 Jun 1993)			
2	18:26509	*See* LBL–33772			
CONF-9306175–		(OPA peer review on electrochemistry and aqueous corrosion of materials: aqueous corrosion emphasis; Washington, DC (United States); 17 Jun 1993)			
1	18:26606	*See* DOE/ER/45461–22			
CONF-9306176–		(Workshop on physics at current accelerators and the supercollider; Argonne, IL (United States); 2-5 Jun 1993)			
1	18:27097	*See* SLAC-PUB–6138			
CONF-9306180–		(9. annual joint Government-Industry symposium on security technology; Virginia Beach, VA (United States); 21-24 Jun 1993)			
1	18:25898	*See* SAND–93-0442C			

CONF-9306183–

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-9306183–		(20. annual meeting of the Microscopical Society of Canada (MSC); Toronto (Canada); 2-5 Jun 1993)			
1	18:26781	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015964	MF-404
CONF-9306188–		(1. workshop on rich detectors; Bari (Italy); 1-5 Jun 1993)			
1	18:27187	*See* FNAL/C–93/148			
CONF-9306189–		(NE '93: 4th annual scientific and technical conference of the Nuclear Society: nuclear energy and human safety; Nizhni Novgorod (USSR); 28 Jun - 2 jul 1993)			
1	18:26388	*See* WSRC-MS–93-048			
CONF-9306192–		(Seminar on economics of proliferation and counterproliferation; McLean, VA (United States); 2 Jun 1993)			
Exec.Summ.	18:26564	*See* SAIC–93015937			
CONF-930630–		(Society for Technical Communication conference; Dallas, TX (United States); 10-13 Jun 1993)			
2	18:28215	*See* WHC-SA–1781			
CONF-930637–		(13. international conference on particles and nuclei; Perugia (Italy); 27 Jun - 3 jul 1993)			
1	18:27766	*See* BNL–48717			
CONF-930644–		(34. US symposium on rock mechanics; Madison, WI (United States); 27-30 Jun 1993)			
5	18:26823	*See* UCRL-JC–111977			
10	18:25756	*See* SAND–92-2124C			
CONF-930647–		(86. annual meeting and exhibition of the Air and Waste Management Association; Denver, CO (United States); 13-18 Jun 1993)			
2	18:26112	*See* ANL/EAIS/CP–78927			
3	18:27269	*See* ANL/EAIS/CP–78850			
CONF-930658–		(5. international conference on welding and melting by electron and laser beams; La Baule (France); 14-18 Jun 1993)			
1	18:26952	*See* UCRL-JC–109388			
CONF-930680–		(1. congress of the International Society for Theoretical Chemistry and Physics; Gerona (Spain); 28 Jun - 3 jul 1993)			
1	18:27721	*See* LA-UR–93-2390			
CONF-930681–		(24. international annual conference of the Fraunhofer Institute of Chemical Technologies; Karlsruhe (Germany); 29 Jun - 2 jul 1993)			
1	18:27257	*See* UCRL-JC–113056			
CONF-930682–		(International workshop on superconductivity; Hokkaido (Japan); 28 Jun - 1 jul 1993)			
1	18:26736	*See* ANL/MSD/CP–79578			
2	18:26748	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015803	MF-404; MF-410
CONF-930687–		(International conference on natural gas hydrates; New Paltz, NY (United States); 20-24 Jun 1993)			
1	18:25611	*See* DOE/METC/C–93/7070			
2	18:25610	*See* DOE/METC/C–93/7069			
CONF-930702–		(Pressure vessels and piping conference; Denver, CO (United States); 25-29 Jul 1993)			
16-Rev.1	18:26387	*See* WSRC-MS–92-370-Rev.1			
17	18:26917	*See* WSRC-MS–93-167			
19	18:26331	*See* WSRC-MS–93-182			
21	18:26280	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012966	MF-1004; MF-1006
22	18:26353	*See* EGG-M–93123			
23	18:26351	*See* EGG-M–92638			
24	18:26734	*See* WHC-SA–1361			
25	18:25798	*See* WHC-SA–1748			
28	18:25674	*See* SAND–92-2237C			
31	18:26892	*See* ANL/XFD/CP–78973			
38	18:26918	*See* ANL/MCT/CP–78185			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
41	18:26559	*See* ANL/MCT/CP–78162			
45	18:26332	*See* WSRC-MS–93-262			
CONF-930703–		(International cryogenic engineering conference and international cryogenic materials conference; Albuquerque, NM (United States); 12-16 Jul 1993)			
1	18:27085	*See* LA-UR–93-1928			
2	18:27699	*See* LA-UR–93-2415			
CONF-930713–		(10. detonation symposium; Boston, MA (United States); 12-16 Jul 1993)			
7	18:27245	*See* LA-UR–93-1545			
8	18:27244	*See* LA-UR–93-1421			
17	18:27246	*See* SAND–92-1910C			
CONF-930720–		(20. European conference on controlled fusion and plasma physics; Lisbon (Portugal); 26-30 Jul 1993)			
3	18:28058	*See* PPPL-CFP–2821			
4	18:28057	*See* PPPL-CFP–2819			
5	18:27996	*See* GA-A–21316			
6	18:27994	*See* GA-A–21306			
7	18:27995	*See* GA-A–21308			
8	18:28054	*See* GA-A–21311			
9	18:27993	*See* GA-A–21304			
10	18:27992	*See* GA-A–21301			
11	18:27947	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015799	MF-426
12	18:27948	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015815	MF-420
CONF-930722–		(Annual meeting of the Society of Photo-Optical Instrumentation Engineers; San Diego, CA (United States); 11-16 Jul 1993)			
1	18:27711	*See* LA-UR–93-1509			
2	18:27710	*See* LA-UR–93-1508			
3	18:27718	*See* LA-UR–93-1798			
4	18:26007	*See* SAND–93-0229C			
CONF-930725–		(3. EPRI steam turbine/generator workshop; Albany, NY (United States); 20-23 Jul 1993)			
1	18:26226	*See* DOE/ER/45461–20			
CONF-930741–		(World congress on neural networks; Portland, OR (United States); 11-15 Jul 1993)			
3	18:28172	*See* LA-UR–93-1983			
CONF-930749–		(34. annual meeting of the Institute of Nuclear Materials Management; Scottsdale, AZ (United States); 18-21 Jul 1993)			
6	18:25819	*See* WSRC-MS–93-056			
CONF-930765–		(SCSC '93: summer computer simulation conference; Boston, MA (United States); 19-21 Jul 1993)			
3	18:26906	*See* SAND–92-2825C			
CONF-930769–		(1993 joint Canadian Society of Civil Engineers-American Society of Civil Engineers (CSCE-ASCE) national conference on environmental engineering; Montreal (Canada); 12-14 Jul 1993)			
2	18:26828	*See* Y/EN–4909			
CONF-930773–		(9. international conference on systems engineering (ICSE '93); Las Vegas, NV (United States); 14-16 Jul 1993)			
2	18:28168	*See* LA-UR–93-1287			
CONF-930778–		(1993 RELAP5 international users meeting; Boston, MA (United States); 6-9 Jul 1993)			
2	18:26228	*See* EGG-M–92703			
3	18:26330	*See* WSRC-MS–92-518			
CONF-930779–		(International cosmic-ray conference; Calgary (Canada); 19-20 Jul 1993)			
2	18:27713	*See* LA-UR–93-1602			
3	18:27716	*See* LA-UR–93-1607			
7	18:27715	*See* LA-UR–93-1606			
10	18:27714	*See* LA-UR–93-1604			
11	18:27712	*See* LA-UR–93-1601			
14	18:27825	*See* LBL–33904			
16	18:27764	*See* ANL-HEP-CP–93-32			
17	18:27765	*See* ANL-HEP-CP–93-33			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-930781–		(12. International Federation of Automatic Control (IFAC) world congress; Sydney (Australia); 19-23 Jul 1993)			
1	18:28134	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012963	MF-406
CONF-930782–		(1. international conference in contact mechanics; Southampton (United Kingdom); 13-15 Jul 1993)			
1	18:28184	*See* SAND–92-2059C			
CONF-930784–		(5. international Fuzzy Systems Association World Congress; Seoul (Korea, Republic of); 4-9 Jul 1993)			
1	18:25892	*See* LA-UR–93-1368			
CONF-930785–		(8. international conference on numerical methods in laminar and trubulent flow; Swansea (United Kingdom); 18-23 Jul 1993)			
1	18:27729	*See* UCRL-JC–112286			
CONF-930786–		(1. Dynamic Testing Agency/National Agency for Finite Element Methods and Standards International conference; Milton Keynes (United Kingdom); 7-9 Jul 1993)			
1	18:27240	*See* SAND–92-1891C			
CONF-930788–		(19. international symposium on shock waves; Marseille (France); 26-30 Jul 1993)			
1	18:26817	*See* SAND–93-0725C			
CONF-930791–		(European C++ Users Group meeting; Munich (Germany); 7-9 Jul 1993)			
1	18:28189	*See* SAND–93-1353C			
CONF-930801–		(Conference of the International Union of Pure and Applied Physics on low temperature physics (LT 20); Eugene, OR (United States); 1-11 Aug 1993)			
2	18:26762	*See* LA-UR–93-1705			
3	18:26818	*See* SAND–93-1324C			
4	18:26711	*See* LBL–34028			
CONF-930803–		(12. biennial conference for the International Association for Structural Mechanics in Reactor Technology (SMIRT 12); Stuttgart (Germany); 16-26 Aug 1993)			
13	18:26598	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015455	
CONF-930804–		(28. intersociety energy conversion engineering conference; Atlanta, GA (United States); 8-13 Aug 1993)			
1	18:28006	*See* LA-UR–93-1564			
9	18:26000	*See* SAND–92-2870C			
CONF-930807–		(16. biennial conference on reactor operating experience; Upton, NY (United States); 16-18 Aug 1993)			
1	18:26345	*See* BNL-NUREG–48890			
CONF-930810–		(Topical meeting on environmental transport and dosimetry; Charleston, SC (United States); 31 Aug - 3 sep 1993)			
1	18:27326	*See* EGG–11265-4001			
5	18:27344	*See* LA-UR–93-1797			
CONF-9308107–		(American Statistical Association (ASA) conference; San Francisco, CA (United States); 11 Aug 1993)			
1	18:28171	*See* LA-UR–93-1981			
CONF-9308111–		(3. international conference of the International Building Performance Simulation Association; Adelaide (Australia); 16-18 Aug 1993)			
1	18:26510	*See* LBL–33945			
CONF-9308124–		(5. international conference on human-computer interaction; Orlando, FL (United States); 8-13 Aug 1993)			
1	18:28135	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015210	MF-505
CONF-930825–		(6. international symposium on environmental degradation of materials in nuclear power systems: water reactors; San Diego, CA (United States); 3-5 Aug 1993)			
1	18:26227	*See* DOE/ER/45461–21			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-930830–		(National conference and exposition on heat transfer; Atlanta, GA (United States); 8-11 Aug 1993)			
17	18:27477	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012967	MF-402
18	18:26921	*See* DOE/METC/C–93/7067			
20	18:26919	*See* BNL–48897			
21	18:26117	*See* BNL-NUREG–48969			
22	18:26889	*See* LBL–33817			
CONF-930851–		(9. American conference on crystal growth: crystal growth, characterization and applications; Baltimore, MD (United States); 1-6 Aug 1993)			
1	18:26814	*See* SAND–93-0300C			
CONF-930873–		(2. international mixed waste symposium; Baltimore, MD (United States); 17-20 Aug 1993)			
1	18:27248	*See* UCRL-JC–113577			
4	18:27625	*See* LA-UR–93-1203			
5	18:25799	*See* WHC-SA–1788			
6	18:25725	*See* LA-UR–93-1205			
7	18:25863	*See* EGG-M–93135			
10	18:25800	*See* WHC-SA–1789			
12	18:25821	*See* WSRC-MS–93-202			
14	18:25801	*See* WHC-SA–1795			
15	18:25808	*See* WHC-SA–1920			
20	18:25809	*See* WHC-SA–1928			
CONF-930881–		(Siggraph '93 conference; Anaheim, CA (United States); 2-6 Aug 1993)			
3	18:28198	*See* UCRL-JC–112572			
CONF-930901–		(Annual meeting of the Society of Exploration Geophysicists; Washington, DC (United States); 26-30 Sep 1993)			
1	18:25597	*See* SAND–93-0811C			
2	18:27668	*See* SAND–93-0823C			
3	18:25606	*See* SAND–93-0824C			
4	18:27464	*See* WSRC-MS–93-179			
CONF-930906–		('93 international conference on nuclear waste management and environmental remediation; Prague (Czech Republic); 5-11 Sep 1993)			
1	18:25815	*See* WSRC-MS–92-268			
2	18:25804	*See* WHC-SA–1830			
3	18:25683	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93007856	MF-510
4	18:25785	*See* WHC-SA–1608			
5	18:25786	*See* WHC-SA–1609			
6	18:25784	*See* WHC-SA–1551			
7	18:25757	*See* SAND–93-7022C			
8	18:25726	*See* LA-UR–93-1598			
9	18:25788	*See* WHC-SA–1630			
10	18:25787	*See* WHC-SA–1623			
CONF-930907–		(ANS topical meeting on physics and methods in criticality safety; Nashville, TN (United States); 19-23 Sep 1993)			
1	18:26899	*See* LA-UR–93-757			
2	18:26359	*See* LA-UR–93-807			
3	18:26916	*See* WHC-SA–1719			
CONF-9309104–		(2. structural applications of mechanical alloying conference; Vancouver (Canada); 20-22 Sep 1993)			
1	18:26701	*See* LA-UR–93-669			
CONF-9309116–		(Conference on vibration and noise; Albuquerque, NM (United States); 20-22 Sep 1993)			
1	18:26891	*See* SAND–93-0567C			
2	18:27724	*See* SAND–92-2240C			
CONF-9309120–		(American Nuclear Society meeting; Nashville, TN (United States); 19-23 Sep 1993)			
1	18:26900	*See* LA-UR–93-758			
2	18:25636	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013515	MF-406
3	18:26902	*See* LA-UR–93-1822			
CONF-9309122–		(5. international symposium on neutron capture therapy; Columbus, OH (United States); 12-17 Sep 1993)			
1	18:27521	*See* BNL–48561			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-9309124–		(18. annual international conference on infrared and millimeter waves; Colchester (United Kingdom); 6-10 Sep 1993)			
2	18:26936	*See* ETDE-IT–93-161			
CONF-9309128–		(International symposium on artificial intelligence; Monterrey (Mexico); 22-24 Sep 1993)			
1	18:25642	*See* WSRC-MS–93-174			
CONF-9309129–		(American Society of Mechanical Engineers (ASME) international electronics packaging conference; Binghampton, NY (United States); 29 Sep - 2 oct 1993)			
1	18:26947	*See* SAND–92-2512C			
CONF-930913–		(Global '93: future nuclear systems - emerging fuel cycles and waste disposal options; Seattle, WA (United States); 12-17 Sep 1993)			
1	18:25727	*See* LA-UR–93-1960			
2	18:25895	*See* LA-UR–93-1818			
3	18:25650	*See* LA-UR–93-1843			
CONF-9309139–		(20. annual National Energy and Environmental Quality Division conference; Indian Wells, CA (United States); 19-22 Sep 1993)			
1	18:25883	*See* WHC-SA–1839			
CONF-9309149–		(HTCMC meeting; No City Given (France); 20-23 Sep 1993)			
1	18:26783	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013532	MF-114
CONF-9309150–		(12. international corrosion congress; Houston, TX (United States); 19-24 Sep 1993)			
1	18:26571	*See* BNL–48665			
2	18:26570	*See* BNL–48655			
3	18:26572	*See* BNL–48706			
4	18:26573	*See* BNL–48707			
5	18:25608	*See* SAND–93-0706C			
CONF-9309151–		(Global '93: international conference and technology exhibition; Seattle, WA (United States); 12-17 Sep 1993)			
2	18:25641	*See* LA-UR–93-1860			
CONF-9309168–		(2. international symposium on productive and quality improvement with a focus on government; Washington, DC (United States); 8-10 Sep 1993)			
1	18:28087	*See* SAND–93-0480C			
CONF-9309185–		(Fluctuations and order: the new synthesis workshop; Los Alamos, NM (United States); 9-12 Sep 1993)			
1	18:27890	*See* LA-UR–93-2155			
CONF-930927–		(3. conference of the European Ceramic Society; Madrid (Spain); 13-17 Sep 1993)			
1	18:26761	*See* LA-UR–93-1518			
CONF-930945–		(International solvent extraction conference (ISEC '93); York (United Kingdom); 9-15 Sep 1993)			
1	18:26839	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001207	MF-401
2	18:26840	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002830	MF-401
3	18:26832	*See* ANL/CHM/CP–75734			
4	18:25678	*See* ANL/CHM/CP–75735			
CONF-930961–		(International conference on high temperature ceramic matrix composites; Bordeaux (France); 20-25 Sep 1993)			
2	18:26782	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015440	MF-114
CONF-930997–		(International symposium on structural intermetallics; Champion, PA (United States); 26-30 Sep 1993)			
1	18:26706	*See* LA-UR–93-1395			
2	18:26599	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015431	MF-404
3	18:26600	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015802	MF-114
CONF-930998–		(Fall committee week of the National Association of Corrosion Engineers; Houston, TX (United States); 26 Sep - 1 oct 1993)			
1	18:26605	*See* DOE/ER/45461–10			
2	18:26225	*See* DOE/ER/45461–11			
3	18:26500	*See* DOE/ER/45461–12			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CPL-B–					
226	18:26266	OSTI; INIS; American Planning Association, 1313 East 60th Street, Chicago, IL 60637 (US)		TI93014749	
CRIE-T–					
91085	18:26543	OSTI; NTIS; Available from Central Research Inst. of Electric Power Industry, 1-6-1, Otemachi, Chiyoda-ku, Tokyo, Japan		DE93798904	
CRN–					
92-09	18:27838	OSTI; NTIS (US Sales Only); INIS		DE93631881	
92-22	18:28136	OSTI; NTIS (US Sales Only); INIS		DE93631732	
92-27	18:27839	OSTI; NTIS (US Sales Only); INIS		DE93631882	
92-43	18:27840	OSTI; NTIS (US Sales Only); INIS		DE93631883	
CRN-CPR–					
90-06	18:27175	OSTI; NTIS (US Sales Only); INIS		DE93631540	
91-01	18:27176	OSTI; NTIS (US Sales Only); INIS		DE93631541	
91-02	18:27177	OSTI; NTIS (US Sales Only); INIS		DE93631551	
DNA-TR–					
90-223	18:27247	*See* UCRL-CR–107172			
DOE–					
76-45/13-Rev.1	18:27657	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013777	MF-900
76-45/28-Rev.1	18:26406	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013697	MF-500
76-45/5-Rev.1	18:27656	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013589	MF-607
93013923	18:25684	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013923	MF-900
DOE-HMIP-RR–					
92.110	18:26267	OSTI; NTIS (US Sales Only); INIS		DE93631577	
92.111	18:25690	OSTI; NTIS (US Sales Only); INIS		DE93631586	
DOE/AD–					
0043	18:28206	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013898	MF-900
0044	18:28207	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013899	MF-900
0046	18:28074	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015997	MF-900
DOE/BC–					
92/3	18:25584	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000116	PC-122
DOE/BC/14205–					
17	18:25585	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000133	PC-122
DOE/BC/14425–					
T11	18:25580	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014664	MF-122
T12	18:25586	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014665	MF-122
T13-App.1-Vol.3	18:25581	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014668	MF-122
T13-App.I-Vol.2	18:25582	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014667	MF-122
DOE/BC/14475–					
12	18:25583	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000139	PC-122
DOE/BC/14831–					
3	18:25587	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014534	MF-122
DOE/BP–					
1574-Ed.2	18:26498	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012213	MF-920
DOE/BP/21065–					
1	18:25982	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016801	MF-902
DOE/BP/41841–					
1	18:25983	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016803	MF-902
DOE/BP/60529–					
1	18:25984	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016804	MF-902
2	18:25985	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016805	MF-902
3	18:25986	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016806	MF-902
5	18:25987	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016808	MF-902
DOE/BP/92818–					
1	18:25988	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016802	MF-902
DOE/BP/94402–					
7	18:25989	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016701	MF-902
DOE/BP/98852–					
1	18:25990	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016702	MF-902
DOE/CE–					
0395	18:26560	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013734	MF-333
0397	18:26038	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016323	MF-250
DOE/CE/15425–					
T11	18:25963	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016295	MF-247
DOE/CE/15474–					
T3	18:27540	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015634	MF-314
DOE/CE/15495–					
T6	18:26896	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016265	MF-310

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
DOE/CE/15974–					
T4	18:25996	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015088	MF-310
DOE/CE/40903–					
2	18:25951	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016242	MF-321
DOE/CH/10093–					
125	18:26463	OSTI; NTIS; GPO Dep.	E 1.99:	DE92001193	MF-201; MF-241
187	18:26499	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013277	MF-350
190	18:26002	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000055	PC-270
DOE/CH/10324–					
T1	18:25654	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016297	MF-820
T10	18:25661	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016307	MF-820
T11	18:25662	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016308	MF-820
T13	18:25853	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016310	MF-820; MF-840
T14	18:25663	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016311	MF-820
T16	18:25664	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016313	MF-820
T17	18:25854	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016314	MF-820; MF-840
T18	18:25665	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016315	MF-820
T19	18:27658	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016316	MF-820
T2	18:25655	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016298	MF-820
T20	18:25666	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016317	MF-820
T21	18:25667	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016318	MF-820
T22	18:25668	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016319	MF-820
T23	18:25669	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016320	MF-840
T24	18:25670	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016321	MF-820
T25	18:25671	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016287	MF-820
T3	18:25656	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016299	MF-820
T4	18:25899	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016300	MF-820
T5	18:25657	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016301	MF-820
T6	18:25658	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016302	MF-820
T7	18:25659	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016303	MF-820; MF-840
T8	18:25660	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016305	MF-820
T9	18:25852	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016306	MF-820
DOE/CR–					
0016	18:26407	OSTI (Free of Charge)		TI93014853	PC-960
DOE/DP/00789–					
T272	18:25685	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012203	MF-721
T277	18:25686	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012208	MF-721
T279	18:26897	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012210	MF-721
DOE/EA–					
0680	18:27270	*See* ANL/EAIS/TM–86			
DOE/EH–					
0317	18:25855	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012804	MF-630
0322	18:26422	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013900	MF-630
0323	18:25900	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015124	MF-630
DOE/EIA–					
0035(93/04)	18:26408	OSTI; NTIS; GPO; GPO Dep.	E 1.99:	DE93012827	MF-950
0121(92/4Q)	18:25556	OSTI; NTIS; GPO; INIS; GPO Dep.	E 1.99:	DE93014500	MF-950
0130(93/05)	18:25615	OSTI; NTIS; GPO; GPO Dep.	E 1.99:	DE93014382	MF-950
0202(93/2Q)	18:26453	OSTI; NTIS; GPO; GPO Dep.	E 1.99:	DE93013134	MF-950
0214(91)	18:26471	OSTI; NTIS; INIS; GPO; GPO Dep.	E 1.99:	DE93013921	MF-950
0226(93/04)	18:26464	OSTI; NTIS; GPO; GPO Dep.	E 1.99:	DE93013290	MF-950
0226(93/05)	18:26465	OSTI; NTIS; GPO; GPO Dep.	E 1.99:	DE93014383	MF-950
0340(92)/1	18:25598	OSTI; NTIS; GPO; INIS; GPO Dep.	E 1.99:	DE93014712	MF-950
0340(92)/2	18:25599	OSTI; NTIS; GPO; INIS; GPO Dep.	E 1.99:	DE93014713	MF-950
0380(93/05)	18:25600	OSTI; NTIS; GPO; GPO Dep.	E 1.99:	DE93014659	MF-950
0455(91)	18:26400	OSTI; NTIS; GPO; INIS; GPO Dep.	E 1.99:	DE93013929	MF-950
0484(93)	18:26460	OSTI; NTIS; INIS; GPO; GPO Dep.	E 1.99:	DE93012998	MF-950
0520(93/05)	18:25601	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015207	MF-950
0538(92/93-27)	18:25602	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012095	MF-950
0538(92/93-29)	18:25603	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012826	MF-950
DOE/EIS–					
0185D-074-Vol.2	18:25856	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003927	MF-902
DOE/EM–					
0089T-Rev.1	18:25687	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014591	MF-902
DOE/ER–					
0587	18:28137	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012376	MF-405

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DOE/ER-ITER–0004	18:28035	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014828	MF-420
DOE/ER/10713–T4	18:27770	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015067	MF-414
DOE/ER/12128–1	18:26749	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016286	MF-404
DOE/ER/13183–8	18:26858	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016203	MF-401
DOE/ER/13359–9	18:25952	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016812	MF-408
DOE/ER/13419–T2	18:26050	OSTI; NTIS; GPO Dep.	E 1.99:	DE93017553	MF-403; MF-401
DOE/ER/13616–7	18:25479	OSTI; NTIS; GPO Dep.	E 1.99:	DE93017057	MF-401
DOE/ER/13709–5	18:27515	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015938	MF-408
DOE/ER/13740–11	18:27914	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014438	MF-410
DOE/ER/13745–3	18:27887	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015075	MF-411
DOE/ER/13749–4	18:27662	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016261	MF-404
DOE/ER/13933–3	18:26859	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016876	MF-401
DOE/ER/13934–T1	18:26886	OSTI; NTIS; GPO Dep.	E 1.99:	DE93017605	MF-401
DOE/ER/13960–5	18:27882	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93017017	MF-406
DOE/ER/14079–24	18:27663	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015882	MF-403
DOE/ER/14090–4	18:27218	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013378	MF-406
DOE/ER/14128–T1	18:26887	OSTI; NTIS; GPO Dep.	E 1.99:	DE93017085	MF-401
DOE/ER/14193–5	18:26860	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016201	MF-401
DOE/ER/14205–2	18:26876	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016289	MF-410
DOE/ER/14225–2	18:27888	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93017603	MF-411
DOE/ER/14273–1	18:26861	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016214	MF-401
DOE/ER/14275–1	18:26784	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016065	MF-402
DOE/ER/14306–1	18:26888	OSTI; NTIS; GPO Dep.	E 1.99:	DE93017086	MF-401
DOE/ER/20037–2	18:27541	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015931	MF-408
DOE/ER/20041–1	18:27516	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015782	MF-408
DOE/ER/20076–1	18:25997	OSTI; NTIS; GPO Dep.	E 1.99:	DE93017200	MF-408
DOE/ER/25015–T1	18:28138	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016512	MF-405
DOE/ER/25133–1	18:28139	OSTI; NTIS; GPO Dep.	E 1.99:	DE93017317	MF-405
DOE/ER/40149–T1	18:27178	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015732	MF-413
DOE/ER/40160–9	18:27771	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015584	MF-414
DOE/ER/40224–232	18:27746	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93010349	MF-414
DOE/ER/40374–70	18:28140	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014886	MF-414
72	18:26996	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014765	MF-414
DOE/ER/40388–102	18:27747	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015096	MF-413
DOE/ER/40427–02-N93	18:27802	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014861	MF-413

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
DOE/ER/40560–					
4A	18:27731	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016863	MF-414
4B	18:27772	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016864	MF-414
4C	18:27748	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016865	MF-414
DOE/ER/40561–					
084	18:27934	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93010348	MF-413
DOE/ER/40648–					
2	18:26964	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015883	MF-414
DOE/ER/40699–					
2	18:27732	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015884	MF-414
DOE/ER/40747–					
2	18:26997	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93017206	MF-414
DOE/ER/40757–					
004	18:27671	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011121	MF-414; MF-405
DOE/ER/40765–					
T1	18:27773	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93017556	MF-414
DOE/ER/40768–					
1	18:27828	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015934	MF-414
DOE/ER/45141–					
9	18:26601	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016666	MF-404
DOE/ER/45237–					
7	18:26785	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016256	MF-401
DOE/ER/45249–					
T2	18:26750	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016296	MF-404
DOE/ER/45298–					
9	18:26786	OSTI; NTIS; GPO Dep.	E 1.99:	DE93017056	MF-401
DOE/ER/45315–					
17	18:26602	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016259	MF-404
DOE/ER/45334–					
6	18:27898	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014440	MF-410
DOE/ER/45362–					
3	18:26787	OSTI; NTIS; GPO Dep.	E 1.99:	DE93017019	MF-404
DOE/ER/45391–					
4	18:26751	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016051	MF-404
DOE/ER/45415–					
6	18:27883	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93010999	MF-411
9	18:27867	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011002	MF-411
DOE/ER/45431–					
3	18:26752	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016129	MF-410
DOE/ER/45438–					
3	18:26788	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016667	MF-404
DOE/ER/45461–					
2	18:26603	OSTI; NTIS; GPO Dep.	E 1.99:	DE93017052	MF-404
9	18:26604	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012924	MF-404
10	18:26605	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012925	MF-404
11	18:26225	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012922	MF-404
12	18:26500	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012923	MF-404
20	18:26226	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014218	MF-404
21	18:26227	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015033	MF-404
22	18:26606	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015501	MF-404
DOE/ER/53297–					
5	18:27949	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016204	MF-420
DOE/ER/54131–					
2	18:27950	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015741	MF-420
DOE/ER/60253–					
9	18:27389	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93017058	MF-402
DOE/ER/60353–					
T1	18:27478	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016257	MF-403
DOE/ER/60405–					
8	18:27647	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93017051	MF-401; MF-408
DOE/ER/60502–					
7	18:27606	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016019	MF-408
DOE/ER/60631–					
11	18:27607	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014482	PC-408
12	18:27608	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014483	PC-408
DOE/ER/60633–					
8	18:27390	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016205	MF-408
DOE/ER/60665–					
T2	18:27391	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014397	MF-402

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
DOE/ER/60721–					
6	18:27909	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015074	MF-413
DOE/ER/60759–					
T1	18:26423	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016365	MF-402
DOE/ER/60970–					
T1	18:27316	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014509	MF-402
DOE/ER/60972–					
3	18:27522	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015880	MF-408
DOE/ER/60980–					
T1	18:27479	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015576	MF-403
DOE/ER/60984–					
3	18:27519	OSTI; NTIS; GPO Dep.	E 1.99:	DE93017053	MF-408
DOE/ER/61012–					
T3	18:27317	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016434	MF-402
DOE/ER/61013–					
T2	18:27480	OSTI; NTIS; GPO Dep.	E 1.99:	DE93017089	MF-403
DOE/ER/61014–					
3	18:27318	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016206	MF-402
DOE/ER/61034–					
2	18:28141	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016814	MF-408
DOE/ER/61040–					
2	18:27517	OSTI; NTIS; GPO Dep.	E 1.99:	DE93017270	MF-408
DOE/ER/61056–					
T1	18:27319	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015312	MF-402
DOE/ER/61228–					
T1	18:27648	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016541	MF-408
DOE/ER/61422–					
1	18:27481	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015059	MF-402
DOE/ER/61423–					
1	18:27482	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015058	MF-402
DOE/ER/61474–					
1	18:27320	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015935	MF-402
DOE/ER/75636–					
1	18:28071	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016288	MF-400
DOE/ER/75730–					
1	18:28075	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016309	MF-400
DOE/ER/75760–					
1	18:26409	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014095	MF-400
DOE/ER/75773–					
1	18:26410	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013538	MF-400
DOE/ER/75842–					
1	18:28072	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012263	MF-400
DOE/FTR–					
93011400	18:28036	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011400	MF-420
93011417	18:27817	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011417	MF-413
93011423	18:27321	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011423	MF-101
93011657	18:26439	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011657	MF-902
93011660	18:27935	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011660	MF-400
93011812	18:26544	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011812	MF-249
93011934	18:26349	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011934	MF-940
93012119	18:26003	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012119	MF-350
93012248	18:26424	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012248	MF-902
93012251	18:27774	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012251	MF-414
93012409	18:26039	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012409	MF-703
93012413	18:26789	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012413	MF-704
93012601	18:26008	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012601	MF-232
93012692	18:27664	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012692	MF-403
93012697	18:25559	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012697	MF-104
93012811	18:26009	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012811	MF-231; MF-232
93012812	18:25913	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012812	MF-404
93012815	18:26501	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012815	MF-500
93012976	18:25688	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012976	MF-902
93012978	18:27322	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012978	MF-402
93013011	18:26413	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93013011	MF-500
93013017	18:27044	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93013017	MF-414
93013020	18:27179	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93013020	MF-706
93013086	18:25588	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93013086	MF-122
93013119	18:25857	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93013119	MF-510
93013121	18:27323	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93013121	MF-502
93013123	18:25689	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93013123	MF-721

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
DOE/FTR–					
93013559	18:27749	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93013559	MF-414
93013562	18:26415	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93013562	MF-400
93014803	18:27951	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93014803	MF-420
93014983	18:28037	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93014983	MF-420
DOE/ID–					
10432	18:27324	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013749	MF-902
10433	18:27325	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013730	MF-902
22105	18:27484	OSTI; NTIS; INIS; Books and Open-File Reports Section, US Geological Survey, Box 25425, Federal Center, Denver, CO 80225; GPO Dep.	E 1.99:	DE93012162	
DOE/ID/01570–					
T164	18:25604	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93000142	PC-122
DOE/ID/12578–					
3-Vol.1	18:26040	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016251	MF-250
3-Vol.2	18:26041	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016252	MF-250
3-Vol.3	18:26032	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016253	MF-250
3-Vol.4	18:26042	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016254	MF-250
3-Vol.5	18:26043	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016255	MF-250
DOE/ID/12842–					
2	18:25589	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000138	PC-122
DOE/ID/12945–					
T10	18:26051	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016285	MF-253
DOE/ID/13025–					
10	18:26031	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015586	MF-250
DOE/ID/13042–					
5	18:27392	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012948	MF-502
6	18:27665	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012945	MF-502
7	18:27393	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012950	MF-902
8	18:27483	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012949	MF-502
DOE/IG–					
0001/93	18:26411	OSTI (Free of Charge)		TI93013305	PC-960
0323	18:25887	OSTI (Free of Charge)		TI93013893	PC-960
0326	18:25858	OSTI (Free of Charge); INIS		TI93013891	PC-960
0327	18:25859	OSTI (Free of Charge); INIS		TI93013894	PC-960
0328	18:28076	OSTI (Free of Charge)		TI93016000	PC-960
0329	18:28077	OSTI (Free of Charge)		TI93016042	PC-960
DOE/LLW–					
165	18:25691	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013744	MF-900
DOE/MA/33222–					
T1	18:28208	OSTI; NTIS; GPO Dep.	E 1.99:	DE93017196	MF-900
DOE/MC/24267–					
3330	18:25480	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000267	PC-109
3331	18:25481	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000268	PC-109
DOE/MC/25135–					
3341	18:26841	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000278	PC-106; PC-109; PC-111
DOE/MC/26302–					
3269	18:25560	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000245	PC-103
DOE/MC/27168–					
93/C0188	18:26479	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013800	MF-110
93/C0189	18:26480	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013801	MF-110
DOE/MC/27351–					
3335	18:25590	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000272	MF-126
3336	18:25612	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000270	PC-126
DOE/MC/28065–					
3371	18:26481	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000288	MF-110
DOE/METC/C–					
93/7063	18:25692	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015579	MF-902
93/7064	18:25609	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013484	MF-132
93/7066	18:25524	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013485	MF-103
93/7067	18:26921	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013483	MF-103
93/7068	18:25613	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014041	MF-109
93/7069	18:25610	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014043	MF-132
93/7070	18:25611	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014039	MF-132
93/7083	18:26482	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015568	MF-110
93/7085	18:25591	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015668	MF-132
DOE/NBM–					
1100-Vol.5	18:25693	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012100	MF-902

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
DOE/NE/32140–					
22	18:25921	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013816	MF-506
DOE/NV/10412–					
5	18:26044	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015588	MF-251
DOE/NV/10845–					
16	18:27485	OSTI; NTIS; GPO Dep.	E 1.99:	DE93017131	MF-703
18	18:27394	OSTI; NTIS; GPO Dep.	E 1.99:	DE93017132	MF-703
T17	18:27395	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015947	MF-703
T18	18:27396	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015948	MF-703
T19	18:27397	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015949	MF-703
DOE/NV/10872–					
T57	18:25694	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014243	MF-814
DOE/OR–					
01-1100-D2	18:25695	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013201	MF-940
01-1136	18:27398	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014394	MF-902
1054-D2	18:25696	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013202	MF-902
DOE/OR/21548–					
074-Vol.2	18:25856	*See* DOE/EIS–0185D-074-Vol.2			
DOE/OR/21822–					
1	18:25927	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016386	MF-247
2	18:25928	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016387	MF-247
3	18:25929	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016388	MF-247
4	18:25930	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016389	MF-247
5	18:25931	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016390	MF-247
6	18:25932	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016391	MF-247
7	18:25933	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016392	MF-247
8	18:25934	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016393	MF-247
9	18:25935	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016394	MF-247
10	18:25936	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016395	MF-247
11	18:25937	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016396	MF-247
12	18:25938	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016397	MF-247
13	18:25939	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016398	MF-247
T1	18:25940	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016385	MF-247
DOE/OR/22014–					
1	18:26790	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016669	MF-332
DOE/PC/79799–					
T17	18:25561	OSTI; NTIS; GPO Dep.	E 1.99:	DE93017043	PC-102; PC-105
DOE/PC/79815–					
T2	18:25525	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014484	PC-108
DOE/PC/79890–					
T1	18:25477	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013529	PC-104; PC-102
DOE/PC/79936–					
T1	18:25526	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012864	PC-108
DOE/PC/88811–					
T17	18:25527	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014507	PC-108
DOE/PC/88933–					
T2	18:25528	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012403	PC-113
DOE/PC/89767–					
T11	18:25529	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013074	PC-108
DOE/PC/89776–					
T14	18:25562	OSTI; NTIS; GPO Dep.	E 1.99:	DE93017029	PC-104
DOE/PC/89865–					
T6	18:25530	OSTI; NTIS; GPO Dep.	E 1.99:	DE93011700	PC-108
T7	18:25531	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013075	PC-108
DOE/PC/89876–					
T18	18:25532	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014938	PC-108
DOE/PC/90033–					
23	18:25533	OSTI; NTIS; GPO Dep.	E 1.99:	DE93011539	PC-108
DOE/PC/90035–					
T1	18:26862	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015780	MF-113
T3	18:26863	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015778	MF-102
T4	18:26864	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015777	MF-102
T5	18:26865	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015776	MF-113
DOE/PC/90258–					
T10	18:25569	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016780	MF-104
T11	18:25570	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016779	MF-104
T3	18:25563	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016787	MF-104
T4	18:25564	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016786	MF-104
T6	18:25565	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016784	MF-104

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
DOE/PC/90258–					
T7	18:25566	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016783	MF-104
T8	18:25567	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016782	MF-104
T9	18:25568	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016781	MF-104
DOE/PC/90307–					
7	18:25534	OSTI; NTIS; GPO Dep.	E 1.99:	DE93017010	MF-109
8	18:25535	OSTI; NTIS; GPO Dep.	E 1.99:	DE93017011	MF-109
DOE/PC/90309–					
10	18:26478	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014520	MF-105
DOE/PC/90312–					
T10	18:25536	OSTI; NTIS; GPO Dep.	E 1.99:	DE93017044	PC-105
DOE/PC/90537–					
T1	18:25537	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015630	MF-108
DOE/PC/90751–					
T15-VOL.1	18:25571	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013076	PC-104
T15-VOL.2	18:25572	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013077	PC-104
T15-VOL.3	18:25573	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013078	PC-104
DOE/PC/91054–					
T6	18:25538	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016858	MF-108
DOE/PC/91257–					
T16	18:25539	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013617	PC-102
T17	18:25540	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013616	PC-102
DOE/PC/91283–					
T7	18:25546	OSTI; NTIS; GPO Dep.	E 1.99:	DE93017023	MF-102
DOE/PC/91305–					
6	18:26791	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016697	MF-102
DOE/PC/92152–					
T3	18:25574	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014949	MF-109
DOE/PETC/TR–					
93/2	18:26922	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013901	PC-114
DOE/PR–					
0048	18:28078	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016903	MF-900
DOE/RL–					
92-12	18:27486	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013032	MF-902
92-18	18:25860	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013051	MF-902
92-21-Rev.1	18:25861	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014915	MF-630
93-09	18:27487	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014038	MF-702
DOE/RL/12523–					
1	18:28073	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015061	MF-900
DOE/RW/00134–					
T2	18:25697	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014510	MF-814
T4	18:25698	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93017134	MF-814
DOE/SF/16306–					
36	18:26010	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016018	MF-231
DOE/SF/19682–					
T1-Vol.2	18:26128	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013226	MF-523
DOE/SR/14069–					
5	18:27514	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015422	MF-402
DOE/SR/15191–					
5	18:27399	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015565	MF-708
DOE/SR/18217–					
2	18:25922	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015421	MF-600
DOE/UMTRA–					
050506-Vol.3-App.F	18:25862	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012928	MF-902
DOE/WIPP–					
92-007	18:25699	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015034	MF-902
93-012	18:25700	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014889	MF-802
DPES–					
1403	18:26281	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93015311	MF-700
DPSP–					
53-1-3-Del.Ver.	18:26282	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93016082	MF-700
53-1-5-Del.Ver.	18:26283	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93016012	MF-700
53-1-7-Del.Ver.	18:26284	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93016014	MF-700
53-368	18:26285	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012423	MF-700
54-1-10-Del.Ver.	18:26288	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93016031	MF-700
54-1-11-Del.Ver.	18:26289	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93016035	MF-700
54-1-8-Del.Ver.	18:26286	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93016039	MF-700
54-1-9-Del.Ver.	18:26287	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93016030	MF-700
54-448	18:26290	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012786	MF-700
55-1-1-Del.Ver.	18:26291	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93016033	MF-700
55-1-2-Del.Ver.	18:26292	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93016032	MF-700
55-1-4-Del.Ver.	18:26293	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93016076	MF-700

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
55-454-4	18:25905	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012424	MF-700
55-454-1-Del.	18:26294	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012787	MF-700
55-454-3-Del.	18:26295	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012788	MF-700
56-1-2-Del.Ver.	18:26296	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93016038	MF-700
58-1-6-Del.Ver.	18:26297	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93016009	MF-700
63-1-2-Del.Ver.	18:26298	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93016040	MF-700
DPST–					
74-485	18:25701	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93016190	MF-721
DPW–					
3660	18:26299	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011163	MF-700
3665	18:25637	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011164	MF-700
3668	18:26300	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011165	MF-700
4358	18:26301	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011130	MF-700
4477	18:26302	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011158	MF-700
DTH-AEF-NT–					
3	18:26118	OSTI; NTIS; INIS		DE93628296	
DTH-LET-RE–					
93-3	18:25953	OSTI; NTIS		DE93500184	
93-4	18:26558	OSTI; NTIS		DE93500188	
DTP–					
92/55.	18:27808	*See* RAL–92-070			
DUN–					
3955	18:26268	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012156	MF-700
5566-1	18:26303	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012056	MF-700
5566-2	18:26304	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012057	MF-700
ECE/ENVWA–					
30	18:26425	OSTI; NTIS (US Sales Only); INIS		DE93630852	
30(add.1)	18:26426	OSTI; NTIS (US Sales Only); INIS		DE93630853	
EDF–					
93-NB-00004	18:26255	OSTI; NTIS (US Sales Only); INIS		DE93631492	
93-NB-00005	18:26129	OSTI; NTIS (US Sales Only); INIS		DE93631499	
93-NJ-00002(Rev.)	18:26130	OSTI; NTIS (US Sales Only); INIS		DE93631500	
EDF-DER-RA–					
1992-1	18:28079	OSTI; NTIS (US Sales Only); INIS		DE93631737	
EGG–					
10617-1216	18:26898	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015080	MF-702
10617-1242	18:27400	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016140	MF-702
10617-2164	18:27653	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011249	
10617-2168	18:27180	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012510	
10617-2182	18:27181	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015524	MF-706
10617-2186	18:26792	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015523	MF-701
11265-4001	18:27326	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011032	MF-702
2610	18:26366	*See* NUREG/CR–6061			
2640	18:26362	*See* NUREG/CR–5759			
2695	18:25733	*See* NUREG/CR–5987			
2698	18:26522	OSTI; NTIS; GPO Dep.	E 1.99:	DE93010368	PC-311; PC-372
EGG-BNCT–					
10119	18:27523	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013698	MF-408
EGG-EEL–					
10498	18:27401	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016668	MF-903
EGG-EELS–					
10666	18:27402	OSTI; INIS; NTIS (documentation only); ESTSC (complete software package), P.O. Box 1020, Oak Ridge, TN 37831-1020; GPO Dep.	E 1.99:	DE93012331	MF-905
EGG-EP–					
10787	18:26030	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016635	MF-251
EGG-ERTP–					
10647	18:25702	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012332	MF-400
EGG-FSP–					
10603	18:25703	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016482	MF-420
EGG-GEO–					
10304-Vol.1	18:26350	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012164	MF-903
EGG-M–					
92494	18:26131	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013661	MF-506; MF-523
92558	18:25704	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013662	
92586	18:27403	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013681	MF-906
92638	18:26351	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013673	
92703	18:26228	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013665	MF-520
93017	18:27659	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013667	MF-607

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
EGG-M–					
93032	18:26352	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013674	
93067	18:26305	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013670	MF-505
93073	18:27609	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013666	MF-607
93090	18:27660	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013513	MF-907
93095	18:25621	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013678	MF-113
93123	18:26353	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013664	
93135	18:25863	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013677	MF-902
93143	18:28080	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013663	MF-506
EGG-NERD–					
8648	18:26354	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93017396	
EGG-RTAP–					
10627	18:26355	OSTI; NTIS; INIS		TI93012330	
EGG-WTD–					
10550	18:25705	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012187	MF-940
10717	18:25864	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016636	MF-902
EMO–					
1096-Vol.2	18:27404	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011969	
ENEA-RT-AMB–					
91-07	18:25980	OSTI; NTIS (US Sales Only)		DE93799213	
91-11	18:27327	OSTI; NTIS (US Sales Only)		DE93799202	
91-15	18:25706	OSTI; NTIS (US Sales Only); INIS		DE93799303	
91-25	18:27328	OSTI; NTIS (US Sales Only)		DE93799222	
92-16	18:27405	OSTI; NTIS (US Sales Only); INIS		DE93799294	
ENEA-RT-DISP–					
92-01	18:27329	OSTI; NTIS (US Sales Only); INIS		DE93799245	
ENEA-RT-ENERG–					
91-06	18:28142	OSTI; NTIS (US Sales Only); INIS		DE93799277	
ENEA-RT-GEN–					
91-01	18:28143	OSTI; NTIS (US Sales Only); INIS		DE93799295	
91-02	18:27610	OSTI; NTIS (US Sales Only); INIS		DE93799269	
ENEA-RT-INN–					
90-29	18:27182	OSTI; NTIS (US Sales Only); INIS		DE93799297	
91-17	18:26935	OSTI; NTIS (US Sales Only); INIS		DE93799289	
91-27	18:26793	OSTI; NTIS (US Sales Only)		DE93799221	
91-40	18:26794	OSTI; NTIS (US Sales Only); INIS		DE93799296	
92-18	18:26449	OSTI; NTIS (US Sales Only)		DE93799210	
92-24	18:28144	OSTI; NTIS (US Sales Only)		DE93799196	
92-25	18:28145	OSTI; NTIS (US Sales Only)		DE93799220	
92-31	18:26998	OSTI; NTIS (US Sales Only); INIS		DE93799302	
92-37	18:28038	OSTI; NTIS (US Sales Only); INIS		DE93799227	
92-38	18:25914	OSTI; NTIS (US Sales Only); INIS		DE93799288	
ENEA-RT-NUCL–					
91-06	18:28040	OSTI; NTIS (US Sales Only); INIS		DE93799307	
91-07	18:27952	OSTI; NTIS (US Sales Only); INIS		DE93799255	
91-08	18:27962	OSTI; NTIS (US Sales Only); INIS		DE93799235	
91-11	18:25888	OSTI; NTIS (US Sales Only); INIS		DE93799290	
91-19	18:28042	OSTI; NTIS (US Sales Only); INIS		DE93799291	
91-21	18:27966	OSTI; NTIS (US Sales Only); INIS		DE93799306	
91-22	18:28044	OSTI; NTIS (US Sales Only); INIS		DE93799308	
92-02	18:28045	OSTI; NTIS (US Sales Only); INIS		DE93799304	
92-08	18:25889	OSTI; NTIS (US Sales Only); INIS		DE93799246	
92-09	18:26194	OSTI; NTIS (US Sales Only); INIS		DE93799247	
92-12	18:28046	OSTI; NTIS (US Sales Only); INIS		DE93799249	
92-14	18:27968	OSTI; NTIS (US Sales Only); INIS		DE93799278	
92-17	18:27976	OSTI; NTIS (US Sales Only); INIS		DE93799305	
92-22	18:27977	OSTI; NTIS (US Sales Only); INIS		DE93799265	
ENEA-RTI-INN–					
92-11	18:26059	OSTI; NTIS (US Sales Only)		DE93799188	
92-20	18:26965	OSTI; NTIS (US Sales Only); INIS		DE93799243	
ENEA-RTI-PCM-IFEC–					
92-04	18:25638	OSTI; NTIS (US Sales Only); INIS		DE93799231	
92-06	18:28039	OSTI; NTIS (US Sales Only); INIS		DE93799234	
ENEA-RTI-STUDI-ENE–					
92-02	18:26450	OSTI; NTIS (US Sales Only)		DE93799204	
92-03	18:26474	OSTI; NTIS (US Sales Only)		DE93799203	
EPA–					
600/R-92-203	18:26502	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014387	MF-350
ES/ER/TM–					
43	18:27398	*See* DOE/OR–01-1136			
59	18:25865	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93010884	MF-902

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
ESG–					
193	18:27014	*See* LBL–32435-Draft			
216	18:27015	*See* LBL–33091			
ESH-EMS–					
920037	18:27406	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015366	MF-703
EST-SIAN–					
22	18:26370	*See* NUREG/IA–0120			
ESTSC–					
000154CYYMP02	18:28146	ESTSC			
000154CYYMP03	18:28147	ESTSC			
000171IPCAT02	18:28148	ESTSC			
000171IPCAT03	18:28149	ESTSC			
000337I036000	18:28150	ESTSC			
000515I036000	18:28151	RADIATION SHIELDING INFORMATION CENTER			
000574IBMPC00	18:28152	ESTSC; As is due to no source code being provided			
000587IBMPC00	18:28153	ESTSC			
000588C017600	18:28154	ESTSC			
000589C017600	18:28155	ESTSC			
000590C017000	18:28156	ESTSC			
000592C760000	18:28157	ESTSC			
ESTSC/NRC–					
000119IBMPC00	18:28158	ESTSC			
000579IBMPC00	18:28159	ESTSC			
ESTSC/NRC/R–					
000364IBMPC01	18:28160	ESTSC			
000572IBMPC00	18:28161	ESTSC			
ETDE-GB–					
480	18:26113	OSTI; NTIS (US Sales Only); INIS; Available from PowerGen plc, 53 New Bond St., London EC2M 1JJ		DE93502647	
ETDE-IT–					
93-153	18:26475	OSTI; NTIS (US Sales Only)		DE93799181	
93-154	18:26049	OSTI; NTIS (US Sales Only); INIS		DE93799182	
93-155	18:26523	OSTI; NTIS (US Sales Only)		DE93799183	
93-156	18:25707	OSTI; NTIS (US Sales Only); INIS		DE93799226	
93-157	18:27524	OSTI; NTIS (US Sales Only); INIS		DE93799228	
93-158	18:26524	OSTI; NTIS (US Sales Only)		DE93799184	
93-159	18:27978	OSTI; NTIS (US Sales Only); INIS		DE93799229	
93-160	18:27611	OSTI; NTIS (US Sales Only); INIS		DE93799230	
93-161	18:26936	OSTI; NTIS (US Sales Only)		DE93799185	
93-162	18:26937	OSTI; NTIS (US Sales Only); INIS		DE93799232	
93-163	18:27979	OSTI; NTIS (US Sales Only); INIS		DE93799233	
93-164	18:27183	OSTI; NTIS (US Sales Only); INIS		DE93799240	
93-164-Suppl.	18:27184	OSTI; NTIS (US Sales Only); INIS		DE93799241	
93-165	18:26518	OSTI; NTIS (US Sales Only)		DE93799186	
93-166	18:25964	OSTI; NTIS (US Sales Only); INIS		DE93799189	
93-167	18:27980	OSTI; NTIS (US Sales Only); INIS		DE93799244	
93-168	18:27981	OSTI; NTIS (US Sales Only); INIS		DE93799248	
93-169	18:26938	OSTI; NTIS (US Sales Only)		DE93799190	
93-170	18:26939	OSTI; NTIS (US Sales Only)		DE93799191	
93-171	18:27982	OSTI; NTIS (US Sales Only); INIS		DE93799253	
93-172	18:27983	OSTI; NTIS (US Sales Only); INIS		DE93799254	
93-173	18:27488	OSTI; NTIS (US Sales Only)		DE93799192	
93-174	18:26451	OSTI; NTIS (US Sales Only)		DE93799193	
93-175	18:27407	OSTI; NTIS (US Sales Only)		DE93799194	
93-176	18:26795	OSTI; NTIS (US Sales Only)		DE93799195	
93-177	18:27489	OSTI; NTIS (US Sales Only); INIS		DE93799197	
93-178	18:26068	OSTI; NTIS (US Sales Only); INIS		DE93799198	
93-179	18:25890	OSTI; NTIS (US Sales Only); INIS		DE93799266	
93-180	18:26940	OSTI; NTIS (US Sales Only); INIS		DE93799267	
93-181	18:27984	OSTI; NTIS (US Sales Only); INIS		DE93799268	
93-182	18:27985	OSTI; NTIS (US Sales Only); INIS		DE93799270	
93-183	18:27986	OSTI; NTIS (US Sales Only); INIS		DE93799271	
93-184	18:27046	OSTI; NTIS (US Sales Only); INIS		DE93799272	
93-185	18:26607	OSTI; NTIS (US Sales Only)		DE93799199	
93-186	18:28051	OSTI; NTIS (US Sales Only); INIS		DE93799273	
93-187	18:26229	OSTI; NTIS (US Sales Only); INIS		DE93799274	
93-188	18:27987	OSTI; NTIS (US Sales Only); INIS		DE93799275	
93-189	18:27988	OSTI; NTIS (US Sales Only); INIS		DE93799276	

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ETDE-IT–					
93-190	18:26941	OSTI; NTIS (US Sales Only)		DE93799200	
93-191	18:26557	OSTI; NTIS (US Sales Only)		DE93799201	
93-192	18:25969	OSTI; NTIS (US Sales Only); INIS		DE93799205	
93-193	18:25998	OSTI; NTIS (US Sales Only)		DE93799214	
93-194	18:26999	OSTI; NTIS (US Sales Only); INIS		DE93799299	
93-195	18:25644	OSTI; NTIS (US Sales Only); INIS		DE93799300	
ETDE/JP-mf–					
93798681	18:26427	OSTI; NTIS; Available from The Society of Chemical Engineers, Japan, 6-19, Kohinata 4-chome, Bukyo-ku, Tokyo, Japan		DE93798681	
93798905	18:26004	OSTI; NTIS; Available from The Institute of Applied Energy, 14-2, Nishishinbashi 1-chome, Minato-ku, Tokyo, Japan		DE93798905	
93798906	18:26432	OSTI; NTIS; Available from The Institute of Applied Energy, 14-2, Nishishinbashi 1-chome, Minato-ku, Tokyo, Japan		DE93798906	
93798907	18:26525	OSTI; NTIS; Available from The Institute of Applied Energy, 14-2, Nishishinbashi 1-chome, Minato-ku, Tokyo, Japan		DE93798907	
93798908	18:25926	OSTI; NTIS; Available from The Institute of Applied Energy, 14-2, Nishishinbashi 1-chome, Minato-ku, Tokyo, Japan		DE93798908	
93798909	18:26561	OSTI; NTIS; Available from The Institute of Applied Energy, 14-2, Nishishinbashi 1-chome, Minato-ku, Tokyo, Japan		DE93798909	
93798910	18:26062	OSTI; NTIS; Available from The Institute of Applied Energy, 14-2, Nishishinbashi 1-chome, Minato-ku, Tokyo, Japan		DE93798910	
93799057	18:26033	OSTI; NTIS; Available from New Energy and Industrial Technology Development Organization, Sunshine 60, 30F 1-1, 3-chome, Higashi-Ikebukuro, Toshima-ku, Tokyo, Japan		DE93799057	
93799058	18:26034	OSTI; NTIS; Available from New Energy and Industrial Technology Development Organization, Sunshine 60, 30F 1-1, 3-chome, Higashi-Ikebukuro, Toshima-ku, Tokyo, Japan		DE93799058	
93799059	18:26035	OSTI; NTIS; Available from New Energy and Industrial Technology Development Organization, Sunshine 60, 30F 1-1, 3-chome, Higashi-Ikebukuro, Toshima-ku, Tokyo, Japan		DE93799059	
93799060	18:26036	OSTI; NTIS; Available from New Energy and Industrial Technology Development Organization, Sunshine 60, 30F 1-1, 3-chome, Higashi-Ikebukuro, Toshima-ku, Tokyo, Japan		DE93799060	
93799061	18:26037	OSTI; NTIS; Available from New Energy and Industrial Technology Development Organization, Sunshine 60, 30F 1-1, 3-chome, Higashi-Ikebukuro, Toshima-ku, Tokyo, Japan		DE93799061	
ETSU-B–					
00337	18:26547	OSTI; NTIS (US Sales Only)		DE93504809	
1278	18:25965	OSTI; NTIS (US Sales Only)		DE93506438	
1305-P1	18:26526	OSTI; NTIS (US Sales Only)		DE93504800	
1313-P2	18:25973	OSTI; NTIS (US Sales Only); INIS		DE93504810	
1313-P3	18:25577	OSTI; NTIS (US Sales Only); INIS		DE93504811	
1313-P4	18:25974	OSTI; NTIS (US Sales Only); INIS		DE93505272	
1313-P5	18:25975	OSTI; NTIS (US Sales Only); INIS		DE93504519	
1314	18:25954	OSTI; NTIS (US Sales Only); INIS		DE93506439	
1322	18:25970	OSTI; NTIS (US Sales Only); INIS		DE93505271	
1374	18:25979	OSTI; NTIS (US Sales Only)		DE93504795	
ETSU-B/MS–					
00192/05/REP	18:25976	OSTI; NTIS (US Sales Only); INIS		DE93505270	
00192/30/REP	18:25955	OSTI; NTIS (US Sales Only)		DE93504798	
ETSU-G–					
151-P10	18:26046	OSTI; NTIS (US Sales Only)		DE93797876	
151-P11	18:26047	OSTI; NTIS (US Sales Only)		DE93504500	
151-P8	18:26045	OSTI; NTIS (US Sales Only)		DE93504501	
ETSU-N–					
124	18:26069	OSTI; NTIS (US Sales Only)		DE93503574	
ETSU-R–					
59	18:26028	OSTI; NTIS (US Sales Only)		DE93503573	

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ETSU-S–					
1160/16	18:26011	OSTI; NTIS (US Sales Only)		DE93504498	
1160/18	18:26012	OSTI; NTIS (US Sales Only)		DE93504815	
1160/19	18:26013	OSTI; NTIS (US Sales Only)		DE93504497	
1160/21	18:26014	OSTI; NTIS (US Sales Only)		DE93504499	
1160/26	18:26015	OSTI; NTIS (US Sales Only)		DE93504496	
1160/27	18:26016	OSTI; NTIS (US Sales Only)		DE93504813	
1160/30	18:26017	OSTI; NTIS (US Sales Only)		DE93504812	
1163/29	18:26018	OSTI; NTIS (US Sales Only)		DE93504814	
1219-P4	18:26019	OSTI; NTIS (US Sales Only)		DE93504799	
1352	18:26020	OSTI; NTIS (US Sales Only)		DE93504518	
1353	18:26503	OSTI; NTIS (US Sales Only)		DE93504804	
1362	18:26021	OSTI; NTIS (US Sales Only)		DE93504517	
ETSU-T–					
05-00155/REP	18:26052	OSTI; NTIS (US Sales Only)		DE93504807	
05-00155/REP-A	18:26053	OSTI; NTIS (US Sales Only)		DE93506442	
ETSU-WN–					
5051	18:26077	OSTI; NTIS (US Sales Only)		DE93505292	
5090	18:26078	OSTI; NTIS (US Sales Only)		DE93504796	
5099	18:26079	OSTI; NTIS (US Sales Only)		DE93504808	
5108	18:26080	OSTI; NTIS (US Sales Only)		DE93797877	
5127	18:26081	OSTI; NTIS (US Sales Only)		DE93504803	
6023	18:26082	OSTI; NTIS (US Sales Only)		DE93504805	
6027	18:26063	OSTI; NTIS (US Sales Only); INIS		DE93770013	
6029-P1	18:26060	OSTI; NTIS (US Sales Only)		DE93506441	
6029-P2	18:26061	OSTI; NTIS (US Sales Only)		DE93506440	
6046	18:26083	OSTI; NTIS (US Sales Only)		DE93505291	
6056/026	18:26065	OSTI; NTIS (US Sales Only); INIS		DE93504801	
ETSU-WV–					
1685	18:26054	OSTI; NTIS (US Sales Only); INIS		DE93504797	
1690-P1	18:26055	OSTI; NTIS (US Sales Only)		DE93504802	
1690-P2	18:26056	OSTI; NTIS (US Sales Only)		DE93504503	
1691	18:26057	OSTI; NTIS (US Sales Only)		DE93504806	
1693	18:26058	OSTI; NTIS (US Sales Only)		DE93504502	
EUR–					
14043/1	18:26132	OSTI; NTIS (US Sales Only); INIS		TI93631501	
14043/2	18:26133	OSTI; NTIS (US Sales Only); INIS		TI93631502	
14043/3	18:26119	OSTI; NTIS (US Sales Only); INIS		TI93631496	
14043/4	18:25708	OSTI; NTIS (US Sales Only); INIS		TI93631572	
14043/5	18:26269	OSTI; NTIS (US Sales Only); INIS		TI93631503	
14043/6	18:26217	OSTI; NTIS (US Sales Only); INIS		TI93631650	
14043/7	18:26270	OSTI; NTIS (US Sales Only); INIS		TI93630790	
14043/8	18:25709	OSTI; NTIS (US Sales Only); INIS		TI93631588	
14232	18:25710	OSTI; NTIS (US Sales Only); INIS		TI93631578	
14605	18:26195	OSTI; NTIS (US Sales Only); INIS		TI93631526	
EUR-CEA-FC–					
1471	18:27989	OSTI; NTIS (US Sales Only); INIS		TI93632000	
1481	18:28052	OSTI; NTIS (US Sales Only); INIS		TI93632039	
FEI–					
2006	18:26245	OSTI; NTIS (US Sales Only); INIS		DE93629679	
2009	18:26230	OSTI; NTIS (US Sales Only); INIS		DE93629673	
2015	18:26231	OSTI; NTIS (US Sales Only); INIS		DE93629674	
2021	18:26196	OSTI; NTIS (US Sales Only); INIS		DE93629726	
2027	18:26306	OSTI; NTIS (US Sales Only); INIS		DE93629735	
2031	18:26197	OSTI; NTIS (US Sales Only); INIS		DE93629727	
2035	18:28209	OSTI; NTIS (US Sales Only); INIS		DE93629816	
2036	18:26198	OSTI; NTIS (US Sales Only); INIS		DE93629728	
2042	18:26199	OSTI; NTIS (US Sales Only); INIS		DE93629729	
2043	18:28210	OSTI; NTIS (US Sales Only); INIS		DE93629817	
2055	18:28211	OSTI; NTIS (US Sales Only); INIS		DE93629818	
FNAL-TM–					
1824	18:27188	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014927	MF-414
1837	18:27189	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014014	MF-414
1838	18:27190	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014928	MF-414
FNAL/C–					
92/345-E	18:27775	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014919	MF-414
92/94	18:27047	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014016	MF-406; MF-414
92/98	18:27048	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014029	MF-406; MF-414
93/044-E	18:27776	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014718	MF-414

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FNAL/C–					
93/045/E	18:27777	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012780	MF-414
93/046-E	18:27185	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014717	MF-414
93/048/E	18:27778	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012779	MF-414
93/049-E	18:27186	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013569	MF-414
93/050-E	18:27779	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014026	MF-414
93/055-E	18:27780	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014719	MF-414
93/075	18:27049	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014920	MF-414
93/108	18:27050	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015534	MF-414
93/110	18:27051	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014921	MF-414
93/113	18:27052	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014922	MF-400
93/118	18:27053	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014925	MF-414
93/119	18:27000	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014923	MF-414
93/123	18:26966	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014924	MF-414
93/126	18:27001	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015133	MF-414
93/130	18:27002	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015533	MF-414
93/135	18:27003	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016376	MF-414
93/146-E	18:27781	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016349	MF-414
93/148	18:27187	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016471	MF-414
FNAL/Pub–					
93-097-A	18:27702	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014007	MF-414
GA-A–					
21257	18:27990	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012776	MF-421
21281	18:28053	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015472	MF-420
21292	18:27991	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014313	MF-421
21301	18:27992	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015476	MF-420
21304	18:27993	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015477	MF-420
21306	18:27994	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015473	MF-426
21308	18:27995	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015474	MF-426
21311	18:28054	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015475	MF-426
21316	18:27996	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014018	MF-426
GANIL-P–					
92-07	18:27841	OSTI; NTIS (US Sales Only); INIS		DE93631884	
92-15	18:27842	OSTI; NTIS (US Sales Only); INIS		DE93631876	
92-16	18:27750	OSTI; NTIS (US Sales Only); INIS		DE93631816	
92-17	18:27843	OSTI; NTIS (US Sales Only); INIS		DE93631896	
92-18	18:27844	OSTI; NTIS (US Sales Only); INIS		DE93631897	
92-19	18:27751	OSTI; NTIS (US Sales Only); INIS		DE93631836	
92-20	18:27845	OSTI; NTIS (US Sales Only); INIS		DE93631885	
92-21	18:27752	OSTI; NTIS (US Sales Only); INIS		DE93631831	
92-22	18:27829	OSTI; NTIS (US Sales Only); INIS		DE93631866	
92-23	18:27846	OSTI; NTIS (US Sales Only); INIS		DE93631886	
92-24	18:27818	OSTI; NTIS (US Sales Only); INIS		DE93631859	
92-25	18:27191	OSTI; NTIS (US Sales Only); INIS		DE93631552	
92-26	18:27192	OSTI; NTIS (US Sales Only); INIS		DE93631543	
92-28	18:27004	OSTI; NTIS (US Sales Only); INIS		DE93631092	
93-02	18:27819	OSTI; NTIS (US Sales Only); INIS		DE93631855	
GANIL-T–					
92-02	18:27782	OSTI; NTIS (US Sales Only); INIS		DE93631838	
GRI–					
93/0050	18:25614	*See* SAND–93-7039			
GTK-YST–					
80	18:27490	OSTI; NTIS; INIS		DE93629316	
81	18:27408	OSTI; NTIS; INIS		DE93629306	
HW–					
18321	18:27409	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93017358	MF-501
18712	18:25639	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93017351	MF-507
18846	18:25866	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93017352	MF-507
27570	18:25867	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93017353	MF-507
54942	18:26307	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93014279	MF-520
65806-RD	18:25645	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93014662	MF-512
73026	18:26271	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012070	MF-711
IAE–					
5008-4	18:26163	OSTI; NTIS (US Sales Only); INIS		DE93628318	
IAEA-TECDOC–					
697	18:26246	OSTI; NTIS (US Sales Only); INIS		DE93628297	
698	18:27612	OSTI; NTIS (US Sales Only); INIS		DE93629414	
700	18:26256	OSTI; NTIS (US Sales Only); INIS		DE93629675	
701	18:26446	OSTI; NTIS (US Sales Only); INIS		DE93629794	
703	18:28216	OSTI; NTIS (US Sales Only); INIS		DE93631721	
707	18:27573	OSTI; NTIS (US Sales Only); INIS		DE93630772	

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IAEA/UNDP–					
INS/88/013-25	18:27588	OSTI; NTIS (US Sales Only); INIS		DE93629392	
INS/88/013-TR	18:27589	OSTI; NTIS (US Sales Only); INIS		DE93629391	
KEN/90/023-TR	18:27590	OSTI; NTIS (US Sales Only); INIS		DE93630773	
ROM/87/002-03	18:26173	OSTI; NTIS (US Sales Only); INIS		DE93631520	
IC–					
93/100	18:27680	OSTI; NTIS (US Sales Only); INIS		DE93628583	
93/104	18:27681	OSTI; NTIS (US Sales Only); INIS		DE93628584	
93/105	18:27756	OSTI; NTIS (US Sales Only); INIS		DE93631822	
93/106	18:27682	OSTI; NTIS (US Sales Only); INIS		DE93631750	
93/108	18:27683	OSTI; NTIS (US Sales Only); INIS		DE93628585	
93/109	18:27783	OSTI; NTIS (US Sales Only); INIS		DE93631837	
93/110	18:27707	OSTI; NTIS (US Sales Only); INIS		DE93631799	
93/111	18:27784	OSTI; NTIS (US Sales Only); INIS		DE93631839	
93/112	18:27736	OSTI; NTIS (US Sales Only); INIS		DE93631804	
93/114	18:27902	OSTI; NTIS (US Sales Only); INIS		DE93632043	
93/116	18:27737	OSTI; NTIS (US Sales Only); INIS		DE93631813	
93/43	18:27672	OSTI; NTIS (US Sales Only); INIS		DE93628586	
93/45	18:27703	OSTI; NTIS (US Sales Only); INIS		DE93627958	
93/46	18:27704	OSTI; NTIS (US Sales Only); INIS		DE93627959	
93/54	18:27673	OSTI; NTIS (US Sales Only); INIS		DE93629857	
93/63	18:27753	OSTI; NTIS (US Sales Only); INIS		DE93628626	
93/67	18:27705	OSTI; NTIS (US Sales Only); INIS		DE93629888	
93/72	18:27674	OSTI; NTIS (US Sales Only); INIS		DE93628587	
93/73	18:28162	OSTI; NTIS (US Sales Only); INIS		DE93628569	
93/75	18:27706	OSTI; NTIS (US Sales Only); INIS		DE93631800	
93/78	18:27666	OSTI; NTIS (US Sales Only); INIS		DE93627954	
93/79	18:27675	OSTI; NTIS (US Sales Only); INIS		DE93628588	
93/80	18:27899	OSTI; NTIS (US Sales Only); INIS		DE93628792	
93/81	18:27754	OSTI; NTIS (US Sales Only); INIS		DE93628627	
93/82	18:27676	OSTI; NTIS (US Sales Only); INIS		DE93628589	
93/83	18:27733	OSTI; NTIS (US Sales Only); INIS		DE93628620	
93/84	18:27734	OSTI; NTIS (US Sales Only); INIS		DE93628621	
93/86	18:27900	OSTI; NTIS (US Sales Only); INIS		DE93628793	
93/88	18:28081	OSTI; NTIS (US Sales Only); INIS		DE93628573	
93/89	18:27997	OSTI; NTIS (US Sales Only); INIS		DE93628761	
93/90	18:27901	OSTI; NTIS (US Sales Only); INIS		DE93628794	
93/92	18:28163	OSTI; NTIS (US Sales Only); INIS		DE93628570	
93/93	18:27677	OSTI; NTIS (US Sales Only); INIS		DE93628590	
93/94	18:27735	OSTI; NTIS (US Sales Only); INIS		DE93628622	
93/96	18:27678	OSTI; NTIS (US Sales Only); INIS		DE93628591	
93/97	18:27679	OSTI; NTIS (US Sales Only); INIS		DE93628592	
93/98	18:27755	OSTI; NTIS (US Sales Only); INIS		DE93631817	
ICSP–					
AL-BOUT-R	18:26371	*See* NUREG/IA–0123			
V2-R100-R	18:26158	*See* NUREG/IA–0108			
IEE-SR–					
238	18:27266	OSTI; NTIS; Available from The Institute of Energy Economics, Dai 10 Mori Biru, 18-1, Toranomon 1-chome, Minato-ku, Tokyo, Japan		DE93798920	
239	18:26433	OSTI; NTIS; Available from The Institute of Energy Economics, Dai 10 Mori Biru, 18-1, Toranomon 1-chome, Minato-ku, Tokyo, Japan		DE93798888	
240	18:26457	OSTI; NTIS; Available from The Institute of Energy Economics, Dai 10 Mori Biru, 18-1, Toranomon 1-chome, Minato-ku, Tokyo, Japan		DE93798889	
IFVE-OKU–					
91-151	18:27054	OSTI; NTIS (US Sales Only); INIS		DE93629633	
91-157	18:27055	OSTI; NTIS (US Sales Only); INIS		DE93628260	
92-94	18:27005	OSTI; NTIS (US Sales Only); INIS		DE93628250	
IFVE-OLU–					
92-115	18:27056	OSTI; NTIS (US Sales Only); INIS		DE93628255	
IFVE-OMVT–					
91-131	18:27684	OSTI; NTIS (US Sales Only); INIS		DE93629858	
92-39	18:26960	OSTI; NTIS (US Sales Only); INIS		DE93628247	
IFVE-ONF–					
92-106	18:27057	OSTI; NTIS (US Sales Only); INIS		DE93628261	

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IFVE-OP–					
91-123	18:27156	OSTI; NTIS (US Sales Only); INIS		DE93629654	
91-142	18:27915	OSTI; NTIS (US Sales Only); INIS		DE93630228	
IFVE-ORI–					
91-160	18:27058	OSTI; NTIS (US Sales Only); INIS		DE93629644	
92-64	18:27059	OSTI; NTIS (US Sales Only); INIS		DE93628262	
IFVE-OTF–					
91-181	18:27738	OSTI; NTIS (US Sales Only); INIS		DE93629905	
IFVE-OUNK–					
91-141	18:27006	OSTI; NTIS (US Sales Only); INIS		DE93629613	
91-158	18:27007	OSTI; NTIS (US Sales Only); INIS		DE93629614	
91-178	18:27157	OSTI; NTIS (US Sales Only); INIS		DE93628272	
92-69	18:27008	OSTI; NTIS (US Sales Only); INIS		DE93628251	
IHEP-OTF–					
91-181.	18:27738	*See* IFVE-OTF–91-181			
91-190	18:27685	OSTI; NTIS (US Sales Only); INIS		DE93629859	
INEL/MISC–					
93065	18:27324	*See* DOE/ID–10432			
93066	18:27325	*See* DOE/ID–10433			
INIS-BR–					
3122	18:26753	OSTI; NTIS (US Sales Only); INIS		DE93629207	
INIS-GB–					
481	18:26218	OSTI; NTIS (US Sales Only); INIS		DE93631647	
483	18:28082	OSTI; NTIS (US Sales Only); INIS		DE93631738	
488	18:26164	OSTI; NTIS (US Sales Only); INIS		DE93631514	
489	18:25672	OSTI; NTIS (US Sales Only); INIS		DE93631012	
INIS-JP–					
013	18:28083	OSTI; NTIS; INIS		DE93508345	
INIS-mf–					
13537	18:26796	OSTI; NTIS (US Sales Only); INIS		DE93629234	
13538	18:26866	OSTI; NTIS (US Sales Only); INIS		DE93628963	
13539	18:27591	OSTI; NTIS (US Sales Only); INIS		DE93629397	
13541	18:27425	OSTI; NTIS (US Sales Only); INIS		DE93627928	
13542	18:27426	OSTI; NTIS (US Sales Only); INIS		DE93629307	
13543	18:27332	OSTI; NTIS (US Sales Only); INIS		DE93629294	
13544	18:26610	OSTI; NTIS (US Sales Only); INIS		DE93630453	
13545	18:26628	OSTI; NTIS (US Sales Only); INIS		DE93630454	
13546	18:26652	OSTI; NTIS (US Sales Only); INIS		DE93630373	
13547	18:26677	OSTI; NTIS (US Sales Only); INIS		DE93630368	
13550	18:26416	OSTI; NTIS (US Sales Only); INIS		DE93631657	
13551	18:26417	OSTI; NTIS (US Sales Only); INIS		DE93631658	
13552	18:27592	OSTI; NTIS (US Sales Only); INIS		DE93630766	
13554	18:27593	OSTI; NTIS (US Sales Only); INIS		DE93630768	
13555	18:27594	OSTI; NTIS (US Sales Only); INIS		DE93630769	
13561	18:27341	OSTI; NTIS (US Sales Only); INIS		DE93630670	
13562	18:25605	OSTI; NTIS (US Sales Only); INIS		DE93631670	
13563	18:25616	OSTI; NTIS (US Sales Only); INIS		DE93631689	
13564	18:25617	OSTI; NTIS (US Sales Only); INIS		DE93630838	
13566	18:26219	OSTI; NTIS (US Sales Only); INIS		DE93631644	
INS–					
956	18:27060	OSTI; NTIS; INIS		DE93508254	
INS-T–					
518	18:27820	OSTI; NTIS; INIS		DE93508341	
INT–					
248/PS	18:27216	OSTI; NTIS (US Sales Only); INIS		DE93629782	
IPEN-PUB–					
371	18:25716	OSTI; NTIS (US Sales Only); INIS		DE93629784	
372	18:25717	OSTI; NTIS (US Sales Only); INIS		DE93629783	
373	18:25625	OSTI; NTIS (US Sales Only); INIS		DE93629070	
375	18:25718	OSTI; NTIS (US Sales Only); INIS		DE93629071	
379	18:27622	OSTI; NTIS (US Sales Only); INIS		DE93629381	
IPNO-DRE–					
92-36	18:27823	OSTI; NTIS (US Sales Only); INIS		DE93628658	
IPPCZ–					
324	18:27999	OSTI; NTIS (US Sales Only); INIS		DE93630197	
ISN–					
92-102	18:27847	OSTI; NTIS (US Sales Only); INIS		DE93631887	
IU/NTC–					
92-16.	18:27798	*See* RAL–92-026			
IVL-B–					
1064	18:27342	OSTI; NTIS		DE93500683	

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1079	18:27343	OSTI; NTIS		DE93500686	
1088	18:25978	OSTI; NTIS		DE93500708	
1092	18:27495	OSTI; NTIS		DE93500712	
1097	18:27496	OSTI; NTIS		DE93500715	
IVO-A–					
10/92	18:26802	OSTI; NTIS		DE93500412	
11/92	18:26152	OSTI; NTIS; INIS		DE93629708	
IYaF–					
91-113	18:27061	OSTI; NTIS (US Sales Only); INIS		DE93629645	
91-115	18:27868	OSTI; NTIS (US Sales Only); INIS		DE93630061	
91-118	18:27195	OSTI; NTIS (US Sales Only); INIS		DE93629753	
91-120	18:27158	OSTI; NTIS (US Sales Only); INIS		DE93629655	
91-121	18:27196	OSTI; NTIS (US Sales Only); INIS		DE93629754	
92-8	18:28000	OSTI; NTIS (US Sales Only); INIS		DE93630186	
92-76	18:27062	OSTI; NTIS (US Sales Only); INIS		DE93629646	
JAERI-M–					
92-202	18:27848	OSTI; NTIS; INIS		DE93508268	
92-211	18:27009	OSTI; NTIS; INIS		DE93508257	
92-215	18:26165	OSTI; NTIS; INIS		DE93508315	
93-020	18:27849	OSTI; NTIS; INIS		DE93508285	
93-021	18:27159	OSTI; NTIS; INIS		DE93508284	
93-024	18:27869	OSTI; NTIS; INIS		DE93508312	
93-027	18:26357	OSTI; NTIS; INIS		DE93508318	
93-029	18:26927	OSTI; NTIS; INIS		DE93508333	
93-030	18:27160	OSTI; NTIS; INIS		DE93508313	
93-032	18:26153	OSTI; NTIS; INIS		DE93508319	
93-035	18:26846	OSTI; NTIS; INIS		DE93508314	
93-037	18:25719	OSTI; NTIS; INIS		DE93797620	
93-038	18:26310	OSTI; NTIS; INIS		DE93508344	
93-045	18:26358	OSTI; NTIS; INIS		DE93508320	
93-047	18:27063	OSTI; NTIS; INIS		DE93508317	
93-050	18:27850	OSTI; NTIS; INIS		DE93508321	
93-051	18:27161	OSTI; NTIS; INIS		DE93508316	
93-062	18:26201	OSTI; NTIS; INIS		DE93508334	
JET-R–					
92-12	18:28001	OSTI; NTIS (US Sales Only); INIS		DE93630187	
JHU/APL-ANSP-M–					
22	18:25921	*See* DOE/NE/32140–22			
JINR-D–					
14-91-395	18:26847	OSTI; NTIS (US Sales Only); INIS		DE93628920	
JINR-E–					
1-91-496	18:27851	OSTI; NTIS (US Sales Only); INIS		DE93630050	
13-92-316	18:27870	OSTI; NTIS (US Sales Only); INIS		DE93630059	
14-92-178	18:27925	OSTI; NTIS (US Sales Only); INIS		DE93630229	
15-92-315	18:28002	OSTI; NTIS (US Sales Only); INIS		DE93630194	
17-92-201	18:27623	OSTI; NTIS (US Sales Only); INIS		DE93627984	
19-91-335	18:27624	OSTI; NTIS (US Sales Only); INIS		DE93629336	
2-91-544	18:27686	OSTI; NTIS (US Sales Only); INIS		DE93629861	
2-91-551	18:27687	OSTI; NTIS (US Sales Only); INIS		DE93629862	
2-91-553	18:27785	OSTI; NTIS (US Sales Only); INIS		DE93630001	
2-91-562	18:27852	OSTI; NTIS (US Sales Only); INIS		DE93630045	
2-91-578	18:27889	OSTI; NTIS (US Sales Only); INIS		DE93630105	
2-91-579	18:27688	OSTI; NTIS (US Sales Only); INIS		DE93629863	
2-91-580	18:27739	OSTI; NTIS (US Sales Only); INIS		DE93629955	
2-92-3	18:27803	OSTI; NTIS (US Sales Only); INIS		DE93630004	
2-92-7	18:27786	OSTI; NTIS (US Sales Only); INIS		DE93629991	
2-92-171	18:27689	OSTI; NTIS (US Sales Only); INIS		DE93628593	
2-92-234	18:27787	OSTI; NTIS (US Sales Only); INIS		DE93629984	
2-92-272	18:27690	OSTI; NTIS (US Sales Only); INIS		DE93629864	
2-92-273	18:27740	OSTI; NTIS (US Sales Only); INIS		DE93629906	
2-92-274	18:27691	OSTI; NTIS (US Sales Only); INIS		DE93629865	
2-92-275	18:27692	OSTI; NTIS (US Sales Only); INIS		DE93629866	
2-92-276	18:27693	OSTI; NTIS (US Sales Only); INIS		DE93629867	
2-92-287	18:27741	OSTI; NTIS (US Sales Only); INIS		DE93629907	
2-92-88	18:27804	OSTI; NTIS (US Sales Only); INIS		DE93630011	
5-92-392	18:27694	OSTI; NTIS (US Sales Only); INIS		DE93628594	
9-92-227	18:27010	OSTI; NTIS (US Sales Only); INIS		DE93629615	
JINR-R–					
1-92-45	18:27853	OSTI; NTIS (US Sales Only); INIS		DE93630039	
10-92-5	18:28212	OSTI; NTIS (US Sales Only); INIS		DE93629815	
11-92-100	18:28165	OSTI; NTIS (US Sales Only); INIS		DE93629819	

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
11-92-126	18:27897	OSTI; NTIS (US Sales Only); INIS		DE93630145	
14-92-321	18:27708	OSTI; NTIS (US Sales Only); INIS		DE93629889	
15-92-312	18:28003	OSTI; NTIS (US Sales Only); INIS		DE93630195	
17-91-340	18:26754	OSTI; NTIS (US Sales Only); INIS		DE93629161	
17-91-341	18:26755	OSTI; NTIS (US Sales Only); INIS		DE93629191	
17-91-342	18:26756	OSTI; NTIS (US Sales Only); INIS		DE93629162	
2-91-569	18:27742	OSTI; NTIS (US Sales Only); INIS		DE93629908	
2-92-302	18:27696	OSTI; NTIS (US Sales Only); INIS		DE93629868	
2-92-40	18:27695	OSTI; NTIS (US Sales Only); INIS		DE93629869	
3-91-512	18:26311	OSTI; NTIS (US Sales Only); INIS		DE93629736	
3-92-230	18:27854	OSTI; NTIS (US Sales Only); INIS		DE93630040	
3-92-245	18:27855	OSTI; NTIS (US Sales Only); INIS		DE93630041	
4-92-152	18:27896	OSTI; NTIS (US Sales Only); INIS		DE93630146	
4-92-253	18:27821	OSTI; NTIS (US Sales Only); INIS		DE93630012	
K/DSRD/FTR–					
150	18:28166	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93009135	MF-500
K/ETO–					
127	18:27894	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016232	MF-411
K/TCD–					
1054	18:25722	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93010258	MF-901
KAERC–					
502/89	18:25626	OSTI; NTIS (US Sales Only); INIS		DE93627689	
503/89	18:25627	OSTI; NTIS (US Sales Only); INIS		DE93627690	
504/89	18:25628	OSTI; NTIS (US Sales Only); INIS		DE93627691	
505/89	18:25629	OSTI; NTIS (US Sales Only); INIS		DE93627692	
802/89	18:27595	OSTI; NTIS (US Sales Only); INIS		DE93627985	
803/89	18:27596	OSTI; NTIS (US Sales Only); INIS		DE93627986	
804/89	18:27597	OSTI; NTIS (US Sales Only); INIS		DE93627987	
903/89	18:27197	OSTI; NTIS (US Sales Only); INIS		DE93628341	
KAPL–					
4737	18:26700	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013221	PC-504
KCL-RAINA–					
6	18:26527	OSTI; NTIS		DE93500421	
KCP–					
613-5041	18:26942	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013937	PC-706
613-5043	18:26943	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013938	PC-706
613-5078	18:26944	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015595	PC-706
613-5125	18:27234	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016579	PC-706
613-5137	18:25720	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012175	MF-700; MF-721
613-5138	18:26528	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013814	MF-900; MF-902
613-5152	18:27429	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015596	PC-706
613-5172	18:26529	OSTI; NTIS; GPO Dep.	E 1.99:	DE93011271	MF-705
613-5221	18:27064	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013434	MF-706
KEK–					
92-20	18:27162	OSTI; NTIS; INIS		DE93508335	
92-21	18:27065	OSTI; NTIS; INIS		DE93508336	
KEMAKTA-AR–					
92-08	18:25721	OSTI; NTIS; INIS		DE93631579	
KTM/E-B–					
124	18:26238	OSTI; NTIS; INIS		DE93629676	
125	18:26154	OSTI; NTIS; INIS		DE93629709	
144	18:26548	OSTI; NTIS		DE93500408	
KWU–					
E412/91/E1002	18:26160	*See* NUREG/IA–0116			
LA–					
12442-MS	18:27263	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013597	PC-900; PC-700
12483-MS	18:28004	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014144	MF-414
12522-C	18:26848	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014376	MF-401; MF-410
12532-MS	18:26530	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016006	MF-367
12554	18:26880	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93013598	PC-711
12559-T	18:27788	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014377	MF-410
12560-T	18:27856	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015863	MF-413
12589-MS	18:25723	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015655	MF-900; MF-906
LA-SUB–					
93-164	18:25724	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93010746	MF-603

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
LA-UR–					
92-2620	18:27520	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014410	MF-900
92-4409	18:27258	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015856	MF-903
93-1142	18:26703	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012633	MF-904; MF-906
93-1150	18:26704	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012632	MF-906
93-1159	18:27709	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012631	
93-1165	18:27649	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012629	MF-408
93-1181	18:28167	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012626	MF-905
93-1201	18:26705	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012663	MF-904
93-1203	18:27625	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012662	MF-940
93-1205	18:25725	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012660	MF-940
93-1212	18:26945	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012658	MF-700
93-1216	18:27871	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012657	MF-700
93-1282	18:26757	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012650	MF-904
93-1285	18:26758	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012649	MF-528
93-1287	18:28168	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012647	MF-705
93-1292	18:27790	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012646	MF-413
93-1304	18:25891	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012644	MF-700
93-1305	18:26483	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012643	
93-1306	18:26759	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012642	MF-310
93-1318	18:28005	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012641	MF-700
93-1322	18:26803	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012640	MF-365
93-1348	18:27806	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012638	MF-412
93-1367	18:27235	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012685	MF-906
93-1368	18:25892	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012684	MF-700
93-1384	18:27932	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012681	MF-906
93-1387	18:26968	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012680	MF-414
93-1395	18:26706	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012675	MF-704
93-1421	18:27244	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012671	MF-741
93-1446	18:27872	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012667	MF-700
93-1449	18:27219	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012665	MF-906
93-1456	18:26760	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012752	
93-1475	18:27873	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012749	MF-700
93-1508	18:27710	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012745	MF-706
93-1509	18:27711	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012744	MF-700
93-1518	18:26761	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012741	MF-365
93-1523	18:27227	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012739	
93-1527	18:26867	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012738	MF-721; MF-701
93-1544	18:26207	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012735	MF-743
93-1545	18:27245	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012734	MF-901
93-1564	18:28006	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012731	MF-910
93-1565	18:28169	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014427	MF-905
93-1569	18:28170	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012730	MF-905
93-1598	18:25726	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012725	MF-940
93-1601	18:27712	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012724	MF-910
93-1602	18:27713	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012723	MF-910
93-1604	18:27714	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012721	MF-910
93-1606	18:27715	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012719	MF-910
93-1607	18:27716	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012718	MF-910
93-1615	18:27260	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012714	MF-703
93-1640	18:27198	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012709	MF-706
93-1657	18:26804	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012707	MF-404
93-1669	18:25893	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014615	MF-700
93-1678	18:26029	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014452	MF-251
93-1686	18:27011	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014565	MF-910
93-1692	18:27857	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014449	MF-413
93-1699	18:27261	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014432	MF-703
93-1704	18:26961	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014431	MF-910
93-1705	18:26762	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014587	MF-704
93-1710	18:26805	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014586	MF-704
93-1711	18:26806	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014585	MF-904; MF-910
93-1715	18:27199	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014584	MF-706
93-1716	18:25915	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014583	MF-706
93-1717	18:26901	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014582	MF-900
93-1727	18:27200	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014579	MF-700
93-1728	18:25894	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014578	MF-706
93-1732	18:27717	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014577	MF-910
93-1736	18:27933	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014576	MF-910

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
93-1737	18:27066	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014575	
93-1743	18:27067	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014574	
93-1752	18:27201	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014572	MF-414
93-1755	18:27903	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014570	MF-406
93-1778	18:27068	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014568	MF-414
93-1782	18:27069	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014567	
93-1785	18:26707	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014566	MF-704
93-1797	18:27344	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014562	MF-402
93-1798	18:27718	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014561	MF-700
93-1816	18:27012	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014557	MF-414
93-1818	18:25895	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014556	MF-940
93-1821	18:27070	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014555	MF-414
93-1822	18:26902	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014554	MF-940
93-1824	18:27697	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014553	MF-700
93-1827	18:27071	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014651	
93-1828	18:27072	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014551	
93-1833	18:27073	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014737	MF-706; MF-700
93-1843	18:25650	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014550	MF-706
93-1847	18:27074	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014548	
93-1848	18:27075	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014547	MF-414
93-1853	18:27076	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014546	MF-905; MF-910
93-1860	18:25641	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014480	MF-706
93-1867	18:27077	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014478	MF-414
93-1868	18:27163	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014477	MF-414
93-1871	18:27078	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014475	
93-1874	18:27164	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014473	MF-910
93-1878	18:25916	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014472	
93-1879	18:26969	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014471	MF-910
93-1880	18:27079	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014470	MF-910
93-1881	18:27080	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014469	
93-1893	18:27081	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014467	MF-906; MF-910
93-1897	18:25917	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014465	MF-414
93-1910	18:27082	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014461	
93-1912	18:27083	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014460	MF-414
93-1919	18:27013	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014458	MF-940
93-1921	18:27165	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014457	MF-414
93-1922	18:27874	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014456	MF-414
93-1924	18:27084	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014455	MF-414
93-1925	18:27875	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014454	MF-414
93-1927	18:26807	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014453	MF-904
93-1928	18:27085	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014393	MF-706
93-1955	18:27086	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014356	MF-414
93-1960	18:25727	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014355	MF-940
93-1965	18:27791	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014353	MF-700
93-1968	18:27719	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014352	MF-700
93-1969	18:27792	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014351	MF-414
93-1970	18:27793	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014350	MF-412
93-1971	18:27824	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014349	MF-414
93-1980	18:26239	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014346	MF-705
93-1981	18:28171	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014345	MF-705
93-1983	18:28172	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014344	MF-905
93-1991	18:26476	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014343	MF-251
93-2021	18:27794	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016631	MF-414
93-2038	18:27087	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014391	MF-414
93-2090	18:26970	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016626	MF-906; MF-910
93-2155	18:27890	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016612	MF-910
93-2323	18:26708	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016460	
93-2326	18:27430	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016459	MF-814
93-2354	18:28055	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016455	MF-910
93-2371	18:27720	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016487	MF-412
93-2390	18:27721	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016524	MF-701
93-2415	18:27699	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016521	MF-363
93-669	18:26701	OSTI; NTIS; GPO Dep.	E 1.99:	DE93008727	MF-904
93-712	18:26702	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011251	
93-757	18:26899	OSTI; NTIS; GPO Dep.	E 1.99:	DE93010711	MF-714
93-758	18:26900	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93010698	MF-714
93-807	18:26359	OSTI; NTIS; GPO Dep.	E 1.99:	DE93010716	MF-714

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
93-861	18:27259	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015858	MF-903
LAL–					
92-09	18:27789	OSTI; NTIS (US Sales Only); INIS		DE93631844	
92-59	18:27805	OSTI; NTIS (US Sales Only); INIS		DE93631851	
LAL-RT–					
93-01	18:26967	OSTI; NTIS (US Sales Only); INIS		DE93631021	
LBL–					
23593	18:25728	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015280	MF-814
29628	18:27525	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015277	MF-408
30508	18:26504	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015372	
31305	18:27626	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013902	MF-350
31469	18:26452	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015281	MF-350
31572	18:26568	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015182	MF-404
31852	18:27910	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015258	PC-411
32165-Rev.3	18:28213	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015292	MF-605
32165-Rev.4	18:27533	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015231	MF-606
32231	18:26399	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015242	MF-221
32362	18:26472	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015219	
32380-Vol.1	18:26505	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015245	
32387	18:26829	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015260	PC-401
32418	18:27431	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015266	MF-902
32435-Draft	18:27014	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015284	MF-414
32461	18:26868	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015267	MF-108
32612	18:27202	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015288	MF-414
32641-Rev.1	18:27526	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013911	MF-605
32826	18:26506	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015235	MF-350
32845	18:26869	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015218	MF-401
32956	18:26870	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015264	MF-401
33031	18:27822	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015269	MF-413
33046	18:26401	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015238	MF-331
33075	18:26507	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015233	MF-350
33089	18:26971	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015223	MF-414
33091	18:27015	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015294	MF-414
33166	18:26473	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015370	MF-920
33201	18:26508	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015240	MF-350
33207	18:25592	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015287	MF-122
33307	18:27166	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015042	MF-414
33429	18:27876	OSTI; NTIS; GPO Dep.	E 1.99:	DE93010447	MF-400
33597	18:25729	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93010450	MF-814
33664	18:26972	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013907	MF-414
33741	18:26466	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016712	MF-902
33749	18:27527	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015375	
33769	18:25541	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015265	MF-109
33771	18:27722	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015039	MF-413
33772	18:26509	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015045	MF-350
33817	18:26889	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015196	MF-310
33830	18:27667	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015224	MF-122; MF-403
33886	18:26946	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013910	MF-404
33904	18:27825	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013914	MF-413
33919-ABS	18:26871	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015035	MF-401
33945	18:26510	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015177	MF-350
33948	18:26709	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013912	MF-404
33952	18:27795	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015179	MF-414
33957	18:27432	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015270	MF-902
33971	18:26763	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013904	MF-404
33976	18:27757	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013906	MF-414
34008	18:27858	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015176	MF-413
34012	18:26710	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015044	MF-404
34028	18:26711	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014914	MF-404
34052	18:27088	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015175	MF-404
34077	18:27796	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015041	MF-414
34118	18:27911	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015043	
34131	18:26877	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015040	MF-401
LBL-PUB–					
3113	18:27627	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013925	MF-407
719	18:26849	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015859	MF-404
LIU-TEK-LIC–					
93-12	18:26467	OSTI; NTIS		DE93500888	
LIYaF–					
1714	18:27203	OSTI; NTIS (US Sales Only); INIS		DE93629762	

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
1770	18:27743	OSTI; NTIS (US Sales Only); INIS		DE93629909	
LNS–					
169	18:26764	OSTI; NTIS; INIS		DE93630537	
LPCC–					
92-02	18:27859	OSTI; NTIS (US Sales Only); INIS		DE93631889	
92-03	18:27860	OSTI; NTIS (US Sales Only); INIS		DE93631890	
92-04	18:27861	OSTI; NTIS (US Sales Only); INIS		DE93631891	
92-05	18:27862	OSTI; NTIS (US Sales Only); INIS		DE93631892	
LPCC-T–					
92-02	18:27863	OSTI; NTIS (US Sales Only); INIS		DE93631888	
LRP–					
472/93	18:25918	OSTI; NTIS; INIS		DE93629552	
LU-SCS-RR–					
91.39	18:26166	OSTI; NTIS (US Sales Only); INIS		DE93628319	
LUNBDS-NBLI–					
93-1025	18:27654	OSTI; NTIS		DE93500855	
LUNKDL-NKBK–					
1038-1-94-93	18:25999	OSTI; NTIS		DE93500862	
LUTMDN-TMVK–					
3149	18:26511	OSTI; NTIS		DE93500689	
3157	18:26928	OSTI; NTIS		DE93500693	
5219	18:27345	OSTI; NTIS		DE93500695	
7010	18:26103	OSTI; NTIS		DE93500698	
LYCEN–					
9250	18:27628	OSTI; NTIS (US Sales Only); INIS		DE93630806	
MAFF-FRTR–					
93	18:27497	OSTI; NTIS (US Sales Only); INIS		DE93630667	
MHSMP–					
92-40	18:26850	OSTI; NTIS; GPO Dep.	E 1.99:	DE93009949	PC-401
92-41	18:25730	OSTI; NTIS; GPO Dep.	E 1.99:	DE93009948	PC-401
93-08	18:26808	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014366	PC-404
MKS–					
92-74	18:25962	*See* SNV–4161			
93-83	18:25968	*See* SNV–4162			
MLM–					
3784	18:27236	OSTI; NTIS; GPO Dep.	E 1.99:	DE93017107	MF-700
MT–					
470	18:27088	*See* LBL–34052			
NEDO-ITE–					
9111	18:26434	OSTI; NTIS; Available from New Energy and Industrial Technology Development Organization, Sunshine 60, 30F 1-1, 3-chome, Higashi-Ikebukuro, Toshima-ku, Tokyo, Japan		DE93799056	
NEDO-P–					
9129	18:26458	OSTI; NTIS; Available from New Energy and Industrial Technology Development Organization, Sunshine 60, 30F 1-1, 3-chome, Higashi-Ikebukuro, Toshima-ku, Tokyo, Japan		DE93799052	
NEI-DK–					
1154	18:27891	OSTI; NTIS; INIS		DE93631920	
1182	18:25924	OSTI; NTIS		DE93500121	
1183	18:25578	OSTI; NTIS		DE93500125	
1184	18:26549	OSTI; NTIS		DE93500138	
1185	18:26550	OSTI; NTIS		DE93500143	
1186	18:25619	OSTI; NTIS		DE93500135	
1187	18:25956	OSTI; NTIS; INIS		DE93500146	
1190	18:26551	OSTI; NTIS		DE93500118	
1191	18:26552	OSTI; NTIS		DE93500102	
1192	18:25547	OSTI; NTIS		DE93500115	
1193	18:26459	OSTI; NTIS		DE93500106	
1194	18:26484	OSTI; NTIS		DE93500259	
1195	18:26104	OSTI; NTIS		DE93500111	
1196	18:26553	OSTI; NTIS		DE93500109	
1197	18:26402	OSTI; NTIS		DE93500356	
1198	18:26084	OSTI; NTIS		DE93500176	
1199	18:25957	OSTI; NTIS		DE93500164	
1200	18:26477	OSTI; NTIS		DE93500179	
1201	18:26085	OSTI; NTIS		DE93500174	
1202	18:26086	OSTI; NTIS		DE93500160	
1203	18:26087	OSTI; NTIS		DE93500171	
1204	18:25958	OSTI; NTIS; INIS		DE93500212	

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1206	18:25959	OSTI; NTIS		DE93500201	
1208	18:26405	OSTI; NTIS		DE93500397	
1209	18:25960	OSTI; NTIS		DE93500393	
1213	18:26022	OSTI; NTIS		DE93500369	
1214	18:25548	OSTI; NTIS		DE93500372	
1216	18:27346	OSTI; NTIS		DE93500359	
1217	18:26512	OSTI; NTIS		DE93500337	
1218	18:26531	OSTI; NTIS		DE93500331	
1220	18:26023	OSTI; NTIS		DE93500319	
1221	18:26024	OSTI; NTIS		DE93500325	
1222	18:27267	OSTI; NTIS		DE93500313	
1224	18:27347	OSTI; NTIS		DE93500375	
1225	18:27348	OSTI; NTIS		DE93500377	
1226	18:27349	OSTI; NTIS		DE93500381	
1227	18:27350	OSTI; NTIS		DE93500383	
1228	18:27351	OSTI; NTIS		DE93500387	
1229	18:27352	OSTI; NTIS		DE93500389	
NEI-SE–					
114	18:26064	OSTI; NTIS; INIS; Also available from: Vattenfall AB, Research Vindenergi, attn. Anders Andersson, Box 88, S-620 20 Klintehamn, Sweden		DE93500836	
117	18:25731	OSTI; NTIS; INIS		DE93631589	
119	18:26468	OSTI; NTIS		DE93500838	
120	18:26712	OSTI; NTIS		DE93500845	
NESC–					
275	18:28150	*See* ESTSC–000337I036000			
278	18:28157	*See* ESTSC–000592C760000			
520	18:28151	*See* ESTSC–000515I036000			
836	18:28158	*See* ESTSC/NRC–000119IBMPC00			
971	18:28156	*See* ESTSC–000590C017000			
9845	18:28154	*See* ESTSC–000588C017600			
9849	18:28155	*See* ESTSC–000589C017600			
NIFS–					
194	18:28007	OSTI; NTIS; INIS		DE93508160	
204	18:28008	OSTI; NTIS; INIS		DE93508331	
206	18:28009	OSTI; NTIS; INIS		DE93508322	
207	18:28010	OSTI; NTIS; INIS		DE93508323	
208	18:28011	OSTI; NTIS; INIS		DE93508324	
209	18:28012	OSTI; NTIS; INIS		DE93508325	
210	18:28013	OSTI; NTIS; INIS		DE93508330	
211	18:28014	OSTI; NTIS; INIS		DE93508326	
212	18:28015	OSTI; NTIS; INIS		DE93508327	
213	18:28016	OSTI; NTIS; INIS		DE93508328	
214	18:28017	OSTI; NTIS; INIS		DE93508329	
NIFS-DATA–					
20	18:27892	OSTI; NTIS; INIS		DE93508346	
NIFS-MEMO–					
7	18:28018	OSTI; NTIS; INIS		DE93508286	
NIKHEF-H–					
92-17	18:27758	OSTI; NTIS; INIS		DE93629973	
92-18	18:27759	OSTI; NTIS; INIS		DE93629974	
NIKHEF-K-DIGEL–					
92-8	18:27089	OSTI; NTIS; INIS		DE93629647	
92-9	18:27090	OSTI; NTIS; INIS		DE93629638	
NIPER–					
646	18:25593	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000143	PC-122
664	18:25594	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000137	PC-122
684	18:25595	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015566	MF-122
690	18:25596	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016005	MF-122; MF-125
NMP–					
92-05	18:26312	OSTI; NTIS; GPO Dep.	E 1.99:	DE93009891	MF-700
NPRW-SA–					
90-5	18:26383	*See* SAND–92-2774			
91-3	18:26382	*See* SAND–91-1544			
NREL/TP–					
411-5013	18:25994	OSTI; NTIS; GPO Dep.	E 1.99:	DE92016430	MF-233; MF-270
441-5611	18:26088	OSTI; NTIS; GPO Dep.	E 1.99:	DE93010031	MF-261
442-4864	18:26089	OSTI; NTIS; GPO Dep.	E 1.99:	DE93010011	MF-261

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471-5536	18:26025	OSTI; NTIS; GPO Dep.	E 1.99:	DE93010026	MF-234
NSF-ITP–					
93-42	18:27757	*See* LBL–33976			
NUREG–					
0040-Vol.17-No.1	18:26211	OSTI; NTIS; INIS; GPO		TI93014865	
0304-Vol.18-No.1	18:26212	OSTI; NTIS; INIS; GPO		TI93014381	
0386-Digest-6-Rev.6	18:26213	OSTI; NTIS; INIS; GPO		TI93014143	
0540-Vol.15-No.4	18:26214	OSTI; NTIS; INIS; GPO		TI93015866	
0837-Vol.13-No.1	18:27433	OSTI; NTIS; INIS; GPO		TI93014899	
0940-Vol.12-No.1	18:26215	OSTI; NTIS; INIS; GPO		TI93015656	
1307-Rev.3	18:25677	OSTI; NTIS; INIS; GPO		TI93014502	
NUREG/CR–					
4599-Vol.2-No.2	18:26240	OSTI; NTIS; INIS; GPO		TI93015295	
4744-Vol.7-No.1	18:26713	OSTI; NTIS; INIS; GPO		TI93015199	
5247-Vol.2	18:26273	OSTI; INIS; GPO; NTIS (documentation only); ESTSC (complete software package), P.O. Box 1020, Oak Ridge, TN 37831-1020		TI93014544	
5305-Vol.2-Pt.1	18:26360	OSTI; NTIS; INIS; GPO		TI93015843	
5305-Vol.2-Pt.2	18:26361	OSTI; NTIS; INIS; GPO		TI93015844	
5410	18:26241	OSTI; NTIS; INIS; GPO		TI93014020	
5759	18:26362	OSTI; NTIS; INIS; GPO		TI93015919	
5778-Vol.3	18:26274	OSTI; NTIS; INIS; GPO		TI93017308	
5943	18:25732	OSTI; NTIS; INIS; GPO		TI93017311	
5955	18:26216	OSTI; NTIS; INIS; GPO		TI93012887	
5966	18:26363	OSTI; NTIS; INIS; GPO		TI93015368	
5983	18:26364	OSTI; NTIS; INIS; GPO		TI93013475	
5987	18:25733	OSTI; NTIS; INIS; GPO		TI93010160	
5996	18:27434	OSTI; NTIS; INIS; GPO		TI93009119	
6013	18:26365	OSTI; NTIS; INIS; GPO		TI93015048	
6031	18:26242	OSTI; NTIS; INIS; GPO		TI93013477	
6041	18:27435	OSTI; NTIS; INIS; GPO		TI93015471	
6061	18:26366	OSTI; NTIS; INIS; GPO		TI93014900	
NUREG/GR–					
0006	18:27353	OSTI; NTIS; INIS; GPO		TI93012310	
NUREG/IA–					
0090	18:26155	OSTI; NTIS; INIS; GPO		TI93015642	
0092	18:26367	OSTI; NTIS; INIS; GPO		TI93016089	
0095	18:26368	OSTI; NTIS; INIS; GPO		TI93015200	
0100	18:26156	OSTI; NTIS; INIS; GPO		TI93016906	
0104	18:26369	OSTI; NTIS; INIS; GPO		TI93015959	
0106	18:26157	OSTI; NTIS; INIS; GPO		TI93016824	
0108	18:26158	OSTI; NTIS; INIS; GPO		TI93015385	
0109	18:26159	OSTI; INIS; GPO; NTIS (documentation only); ESTSC (complete software package), P.O. Box 1020, Oak Ridge, TN 37831-1020		TI93015050	
0116	18:26160	OSTI; NTIS; INIS; GPO		TI93014893	
0120	18:26370	OSTI; NTIS; INIS; GPO		TI93016067	
0123	18:26371	OSTI; NTIS; INIS; GPO		TI93016059	
NUTEK-AVF–					
93-1	18:25962	*See* SNV–4161			
93-1	18:25967	*See* SNV–4160			
93-1	18:25968	*See* SNV–4162			
NUTEK-B–					
93-1	18:26440	OSTI; NTIS		DE93500865	
NUTEK-FBT–					
93-7	18:27354	OSTI; NTIS		DE93500726	
93-8	18:26809	OSTI; NTIS		DE93500731	
93-9	18:26872	OSTI; NTIS		DE93500737	
NUTEK-FGT–					
93-1	18:25542	OSTI; NTIS		DE93500741	
93-2	18:25543	OSTI; NTIS		DE93500745	
NUTEK-R–					
92-31	18:25971	OSTI; NTIS; INIS		DE93500661	
92-43	18:26418	OSTI; NTIS; INIS		DE93631659	
92-44	18:26469	OSTI; NTIS; INIS		DE93500665	
NUTEK-TORV–					
93-1	18:25549	OSTI; NTIS		DE93500749	
NUTEK-VK–					
93-9	18:25966	OSTI; NTIS		DE93500755	

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OCDO–					
93013791	18:25554	OSTI; Ohio Coal Development Office, 77 S. High Street, P.O. Box 1001, Columbus, OH 43266-0001		TI93013791	
93013792	18:26109	OSTI; Ohio Coal Development Office, 77S. High Street, P.O. Box 1001, Columbus, OH 43266-0001		TI93013792	
93013793	18:26110	OSTI; Ohio Coal Development Office, 77 S. High Street, P.O. Box 1001, Columbus, OH 43266-001 (United States)		TI93013793	
93013794	18:25555	OSTI; Ohio Coal Development Office, 77 S. High Street, P.O. Box 1001, Columbus, OH 43266-0001 (United States)		TI93013794	
OEFZS–					
4620	18:27436	OSTI; NTIS (US Sales Only); INIS		DE93628436	
4623	18:26810	OSTI; NTIS (US Sales Only); INIS		DE93627893	
4628	18:27629	OSTI; NTIS (US Sales Only); INIS		DE93628039	
4631	18:26811	OSTI; NTIS (US Sales Only); INIS		DE93627894	
4637	18:25846	OSTI; NTIS (US Sales Only); INIS		DE93628044	
4638	18:25847	OSTI; NTIS (US Sales Only); INIS		DE93628045	
4657	18:27498	OSTI; NTIS (US Sales Only); INIS		DE93627956	
4660	18:27355	OSTI; NTIS (US Sales Only); INIS		DE93628040	
4663	18:27204	OSTI; NTIS (US Sales Only); INIS		DE93628343	
4664	18:27437	OSTI; NTIS (US Sales Only); INIS		DE93628041	
4666	18:27438	OSTI; NTIS (US Sales Only); INIS		DE93628021	
4670	18:27630	OSTI; NTIS (US Sales Only); INIS		DE93628006	
4673	18:25919	OSTI; NTIS (US Sales Only); INIS		DE93628203	
OITS–					
480	18:27746	*See* DOE/ER/40224–232			
ORNL/CON–					
353	18:26497	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015633	
364	18:26554	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016238	MF-222; MF-950
ORNL/ER–					
12	18:25734	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014339	MF-902
ORNL/ER/Sub–					
87-99053/64	18:25735	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93009335	MF-902
ORNL/FTR–					
4112	18:26532	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011085	MF-350
4118	18:26275	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011086	MF-522
4170	18:26412	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011091	MF-400
4175	18:27518	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011055	MF-408
4178	18:26276	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011054	MF-520
4188	18:27499	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011295	MF-402
4204	18:26243	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011109	
4242	18:26519	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011082	MF-400
4256	18:26372	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011083	
4270	18:26903	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011065	MF-406
4271	18:27528	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011101	MF-407
4280	18:26851	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011067	MF-406
4290	18:27650	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011075	MF-407
4292	18:26244	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011074	
4299	18:27091	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012810	MF-414
4307	18:27092	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012975	MF-414
4353	18:27826	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93013006	MF-413
4369	18:27439	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012246	MF-402
4376	18:26904	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012354	
4381	18:26765	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012414	MF-404
4412	18:26167	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011398	MF-1020
4413	18:27440	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011664	MF-402
4426	18:27441	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93009931	MF-402
4452	18:27442	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93009942	MF-402
4453	18:27356	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93009935	MF-402
4455	18:27443	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93009936	MF-402
4496	18:25736	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93009563	MF-810
4509	18:27500	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93009785	MF-402
4510	18:27444	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93009784	MF-402
4552	18:27445	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011815	
4574	18:25920	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011816	MF-410
4634	18:27220	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93016671	MF-406

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
ORNL/FTR–					
4650	18:27221	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93016672	MF-406
ORNL/M–					
2426	18:26502	*See* EPA–600/R-92-203			
2533	18:27501	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93008983	MF-902
ORNL/NPR–					
92/64	18:26373	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93013423	MF-1030
92/65	18:26714	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93013450	MF-1030
ORNL/Sub–					
85-27413/7	18:25944	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015359	MF-243; MF-247
86-22044/2	18:26533	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013451	MF-310
ORNL/TM–					
11838	18:25737	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012513	MF-902
12048	18:27446	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014341	MF-902; MF-905
12058	18:25738	OSTI; NTIS; GPO Dep.	E 1.99:	DE93009337	
12142	18:27447	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012428	MF-903
12177	18:27448	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93010428	MF-902
12234	18:25632	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013844	MF-405
12266	18:26216	*See* NUREG/CR–5955			
12269	18:28173	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012783	MF-405
12311	18:27205	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015757	MF-607
12315	18:25739	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013460	MF-902
12324	18:27449	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014151	MF-402
12356	18:28174	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013805	MF-405
12361	18:26520	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015360	
PATENTS-US–					
A7677738	18:26534	OSTI; NTIS; GPO Dep.	E 1.99:	DE93008232	MF-706; MF-701
A7681292	18:27357	OSTI; NTIS; GPO Dep.	E 1.99:	DE93008216	MF-706
A7710207	18:27217	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015703	MF-706
A7710208	18:26881	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015704	MF-501
A7711235	18:25896	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015705	MF-706
A7711693	18:28056	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015707	MF-421
A7738001	18:27532	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015728	MF-401
PCCF-T–					
92-07	18:27807	OSTI; NTIS (US Sales Only); INIS		DE93631847	
92-09	18:27797	OSTI; NTIS (US Sales Only); INIS		DE93631842	
PNL–					
6415-Rev.5	18:27450	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93010161	MF-630
7722	18:25687	*See* DOE/EM–0089T-Rev.1			
8266	18:25740	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93008627	MF-510
8334	18:27451	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013934	MF-903
8359	18:25772	*See* WHC-EP–0569-Rev.1			
8438	18:25741	OSTI; NTIS; GPO Dep.	E 1.99:	DE93008949	MF-721
8451	18:26161	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012875	PC-510
8478	18:27452	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93009154	MF-902
8483	18:26535	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014863	MF-310
8484	18:26536	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015684	MF-310
8499	18:27434	*See* NUREG/CR–5996			
8500-Pt.2	18:27453	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013932	MF-407
8500-Pt.4	18:27631	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013936	MF-408
8518	18:25742	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93007930	MF-510
8550	18:27358	OSTI; NTIS; GPO Dep.	E 1.99:	DE93009496	MF-506
8551	18:27359	OSTI; NTIS; GPO Dep.	E 1.99:	DE93009495	MF-520
8552	18:27360	OSTI; NTIS; GPO Dep.	E 1.99:	DE93009499	MF-506
8553	18:27361	OSTI; NTIS; GPO Dep.	E 1.99:	DE93009500	MF-502
8554	18:27362	OSTI; NTIS; GPO Dep.	E 1.99:	DE93009497	MF-506
8555	18:27363	OSTI; NTIS; GPO Dep.	E 1.99:	DE93009498	MF-502
8577	18:26241	*See* NUREG/CR–5410			
8580	18:27454	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93010929	MF-403
8588	18:26470	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014849	MF-920
8598	18:25868	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016577	MF-902
8601	18:25743	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014684	MF-721
8622	18:26767	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014590	MF-313
8642	18:27879	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015607	MF-400
8651	18:27265	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014148	MF-706
8653	18:27502	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014372	MF-902
8654	18:27455	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014149	MF-603

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
8656	18:27503	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016831	
8675	18:27456	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016575	MF-902
8705	18:26513	OSTI; NTIS; GPO Dep.	E 1.99:	DE93017527	MF-350
8715	18:26514	OSTI; NTIS; GPO Dep.	E 1.99:	DE93017525	MF-350
SA-22038	18:26873	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015689	MF-404
PNL-SA–					
21455	18:25744	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93010189	MF-510
21482	18:25745	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93007873	MF-510
21596	18:27632	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013824	PC-607
21610	18:28183	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015677	MF-900
21614	18:27457	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015699	MF-902
21621	18:26496	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015696	MF-901
21677	18:27633	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015691	
21693	18:26812	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015688	MF-404
21716	18:25746	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93009325	MF-905; MF-902
21721	18:26852	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015695	
21832	18:25869	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93009481	MF-630
21870	18:25870	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93010166	MF-402
21879	18:25871	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93010171	MF-630
21885	18:25747	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93010168	MF-721
21891	18:25872	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93009814	MF-940
21895	18:25873	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93009812	MF-902
21987	18:25874	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93010172	MF-902
22007	18:26853	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015687	MF-408
22070	18:25748	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93017124	MF-940
22080	18:27364	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013163	MF-902
22089	18:25749	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012868	
22163	18:27237	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93013151	
22200	18:27926	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013506	MF-414
22257	18:26715	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013161	MF-404
22322	18:25750	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013505	MF-901
22329	18:27504	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016159	MF-908
22390	18:27365	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015675	MF-902
22461	18:26537	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015674	MF-900; MF-902
22528	18:26515	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016087	MF-350
22622	18:27505	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016160	MF-500
22687	18:25751	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93017217	MF-510
22693	18:27268	OSTI; NTIS; GPO Dep.	E 1.99:	DE93017149	MF-905
PNWD–					
2033-HEDR-Vol.2	18:27366	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011908	
2127-HEDR	18:27634	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012828	
2131	18:26516	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016399	MF-350
PPPL–					
2900	18:28019	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014592	PC-426
2905	18:28020	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014818	PC-420; PC-426
2906	18:28021	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014596	PC-427
2907	18:28022	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014597	PC-421; PC-427
2913	18:28023	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014820	PC-420; PC-421; PC-422; PC-424
PPPL-CFP–					
2819	18:28057	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014644	MF-414
2821	18:28058	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014645	MF-414
PSI–					
124	18:26447	OSTI; NTIS; INIS		DE93629799	
126	18:26005	OSTI; NTIS		DE93505269	
93-02	18:26435	OSTI; NTIS; INIS		DE93631663	
93-03	18:26461	OSTI; NTIS; INIS		DE93630827	
RAE–					
8915/3-3	18:25724	*See* LA-SUB–93-164			
RAL–					
92-026	18:27798	OSTI; NTIS (US Sales Only); INIS		DE93631843	
92-050-V1	18:28084	OSTI; NTIS (US Sales Only); INIS		DE93631739	
92-050-V2	18:28085	OSTI; NTIS (US Sales Only); INIS		DE93631740	
92-070	18:27808	OSTI; NTIS (US Sales Only); INIS		DE93631849	
92-073	18:27760	OSTI; NTIS (US Sales Only); INIS		DE93629975	

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RAL–					
93-002	18:27744	OSTI; NTIS (US Sales Only); INIS		DE93629956	
93-003	18:27761	OSTI; NTIS (US Sales Only); INIS		DE93631818	
RDA-TR–					
0263229003-001	18:27247	*See* UCRL-CR–107172			
REFR–					
93-9	18:26517	OSTI; NTIS		DE93500857	
RFP–					
4599	18:27661	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013895	PC-707
4677	18:27506	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012699	MF-702
4704	18:26905	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015419	MF-714
4713	18:27635	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015362	MF-630
4714	18:25875	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015412	MF-610
4723	18:25876	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012703	MF-606
RISO-R–					
660(EN)	18:27904	OSTI; NTIS; INIS		DE93630213	
RT/AMB–					
91-07	18:25980	*See* ENEA-RT-AMB–91-07			
91-11	18:27327	*See* ENEA-RT-AMB–91-11			
91-15	18:25706	*See* ENEA-RT-AMB–91-15			
91-25	18:27328	*See* ENEA-RT-AMB–91-25			
92-16	18:27405	*See* ENEA-RT-AMB–92-16			
RT/DISP–					
92-01	18:27329	*See* ENEA-RT-DISP–92-01			
RT/ENERG–					
91-06	18:28142	*See* ENEA-RT-ENERG–91-06			
RT/GEN–					
91-01	18:28143	*See* ENEA-RT-GEN–91-01			
91-02	18:27610	*See* ENEA-RT-GEN–91-02			
RT/INN–					
90-29	18:27182	*See* ENEA-RT-INN–90-29			
91-17	18:26935	*See* ENEA-RT-INN–91-17			
91-27	18:26793	*See* ENEA-RT-INN–91-27			
91-40	18:26794	*See* ENEA-RT-INN–91-40			
92-18	18:26449	*See* ENEA-RT-INN–92-18			
92-24	18:28144	*See* ENEA-RT-INN–92-24			
92-25	18:28145	*See* ENEA-RT-INN–92-25			
92-31	18:26998	*See* ENEA-RT-INN–92-31			
92-37	18:28038	*See* ENEA-RT-INN–92-37			
92-38	18:25914	*See* ENEA-RT-INN–92-38			
RT/NUCL–					
91-06	18:28040	*See* ENEA-RT-NUCL–91-06			
91-07	18:27952	*See* ENEA-RT-NUCL–91-07			
91-08	18:27962	*See* ENEA-RT-NUCL–91-08			
91-11	18:25888	*See* ENEA-RT-NUCL–91-11			
91-19	18:28042	*See* ENEA-RT-NUCL–91-19			
91-21	18:27966	*See* ENEA-RT-NUCL–91-21			
91-22	18:28044	*See* ENEA-RT-NUCL–91-22			
92-02	18:28045	*See* ENEA-RT-NUCL–92-02			
92-08	18:25889	*See* ENEA-RT-NUCL–92-08			
92-09	18:26194	*See* ENEA-RT-NUCL–92-09			
92-12	18:28046	*See* ENEA-RT-NUCL–92-12			
92-14	18:27968	*See* ENEA-RT-NUCL–92-14			
92-17	18:27976	*See* ENEA-RT-NUCL–92-17			
92-22	18:27977	*See* ENEA-RT-NUCL–92-22			
RTI-INN–					
92-11	18:26059	*See* ENEA-RTI-INN–92-11			
92-20	18:26965	*See* ENEA-RTI-INN–92-20			
RTI-NUCL-FUS-BRA-ISP–					
90	18:28059	OSTI; NTIS (US Sales Only); INIS		DE93799301	
RTI/STUDI-ENE–					
92-2	18:26450	*See* ENEA-RTI-STUDI-ENE–92-02			
92-3	18:26474	*See* ENEA-RTI-STUDI-ENE–92-03			
RVF–					
92-11	18:26114	OSTI; NTIS; INIS		DE93500659	
92-17	18:25967	*See* SNV–4160			
92-17-1	18:25962	*See* SNV–4161			
92-17-2	18:25968	*See* SNV–4162			
Riso-R–					
665(EN)	18:27636	OSTI; NTIS; INIS		DE93630799	
669(EN)	18:25544	OSTI; NTIS; Also available from Risoe Library, P.O. Box 49, DK-4000 Roskilde, Denmark		DE93500191	

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680(EN)	18:28086	OSTI; NTIS; INIS		DE93631741	
SAIC–					
93015937	18:26564	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015937	MF-700
SAND–					
87-1305	18:25752	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015729	MF-814
90-2765-Vol.2-Pt.1	18:26360	*See* NUREG/CR–5305-Vol.2-Pt.1			
90-2765-Vol.2-Pt.2	18:26361	*See* NUREG/CR–5305-Vol.2-Pt.2			
91-1544	18:26382	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93013950	MF-1030
92-1172	18:25753	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014407	MF-721
92-1173	18:25754	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013960	MF-902
92-1411	18:27238	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013957	MF-706
92-1777	18:25755	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013897	MF-602
92-1888C	18:27239	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013755	MF-705
92-1891C	18:27240	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013774	MF-706
92-1910C	18:27246	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014991	MF-742
92-1967	18:27723	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015084	MF-706
92-2059C	18:28184	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012846	MF-705
92-2090C	18:26931	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013773	MF-706
92-2124C	18:25756	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015026	MF-940
92-2210C	18:27228	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93013772	MF-706
92-2237C	18:25674	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015021	MF-940
92-2240C	18:27724	OSTI; NTIS; GPO Dep.	E 1.99:	DE93010690	MF-700
92-2296C	18:25877	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011684	MF-903
92-2460C	18:26932	OSTI; NTIS; GPO Dep.	E 1.99:	DE93011619	MF-700
92-2490C	18:26769	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013776	MF-701
92-2508C	18:26716	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013766	MF-704
92-2512C	18:26947	OSTI; NTIS; GPO Dep.	E 1.99:	DE93011683	MF-706
92-2689	18:26363	*See* NUREG/CR–5966			
92-2712C	18:26933	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013764	MF-706
92-2765	18:28185	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015125	MF-405
92-2774	18:26383	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93015608	MF-940; MF-1030
92-2782C	18:25897	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93013762	MF-706
92-2789C	18:26026	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015030	MF-231
92-2795C	18:27458	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015014	MF-802
92-2816	18:27229	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93013949	MF-706
92-2825C	18:26906	OSTI; NTIS; GPO Dep.	E 1.99:	DE93011682	MF-706
92-2829C	18:26006	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015031	MF-270
92-2831C	18:26027	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015006	MF-275
92-2867C	18:26813	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015025	MF-234
92-2870C	18:26000	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016493	MF-236
92-2872C	18:26001	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014996	MF-275
92-2903C	18:26555	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012850	MF-705
93-0027	18:26717	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013956	
93-0094	18:27249	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93015081	MF-706
93-0100C	18:27459	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013753	MF-902
93-0229C	18:26007	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016500	MF-236
93-0300C	18:26814	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015028	MF-701
93-0370C	18:27230	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016492	MF-706
93-0442C	18:25898	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015648	MF-706
93-0463C	18:25878	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015123	MF-700
93-0466C	18:26436	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012860	MF-940
93-0480C	18:28087	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015122	MF-700
93-0482C	18:27877	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014999	MF-706; MF-708
93-0567C	18:26891	OSTI; NTIS; GPO Dep.	E 1.99:	DE93009834	MF-704
93-0706C	18:25608	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016495	MF-126
93-0725C	18:26817	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013767	MF-704
93-0735	18:28186	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013958	MF-705
93-0811C	18:25597	OSTI; NTIS; GPO Dep.	E 1.99:	DE93011668	
93-0823C	18:27668	OSTI; NTIS; GPO Dep.	E 1.99:	DE93011667	MF-122
93-0824C	18:25606	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011666	MF-122
93-0869C	18:28214	OSTI; NTIS; GPO Dep.	E 1.99:	DE93011588	MF-700
93-0910	18:26948	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015128	MF-706
93-0961	18:28187	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014852	MF-905
93-1002C	18:28188	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015011	MF-706
93-1010C	18:27878	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015015	MF-700
93-1011	18:26908	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015082	MF-705
93-1013C	18:26718	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013770	MF-704

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
SAND–					
93-1031C	18:27367	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014992	MF-906; MF-902
93-1067C	18:26384	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012853	
93-1068C	18:26770	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014998	MF-310
93-1069C	18:26890	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012340	MF-701
93-1271C	18:26048	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015659	MF-253
93-1280C	18:26949	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015019	MF-706
93-1289C	18:28060	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015646	MF-712
93-1324C	18:26818	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014990	MF-700
93-1353C	18:28189	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015027	MF-705
93-7022C	18:25757	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011688	MF-902
93-7039	18:25614	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015631	
93-7067C	18:27016	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015022	MF-700
93-8235	18:26538	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016048	MF-902
SC-MAG–					
409	18:27088	*See* LBL–34052			
SCPRI-RM–					
1-1993	18:27368	OSTI; NTIS (US Sales Only); INIS		DE93630787	
SDC–					
93-499	18:27169	*See* ANL-HEP-TR–93-36			
SKB-TR–					
92-33	18:25758	OSTI; NTIS; INIS		DE93631590	
92-35	18:25759	OSTI; NTIS; INIS		DE93631591	
SLAC–					
417	18:27912	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016172	PC-414
SLAC-ABC–					
49	18:27014	*See* LBL–32435-Draft			
SLAC-PUB–					
5832	18:27799	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015246	MF-414
5967	18:28190	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015247	MF-414
6035	18:27167	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015598	MF-414
6078	18:26819	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015251	MF-414
6097	18:26973	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015252	MF-414
6098	18:27093	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015599	MF-414
6123	18:27017	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015602	MF-414
6130	18:27094	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015600	MF-414
6131	18:27095	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015603	MF-414
6134	18:27096	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015253	MF-414
6138	18:27097	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015254	MF-414
6142	18:27098	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015604	MF-414
6152	18:27099	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015605	MF-414
SLAC/SSRL–					
0015	18:26819	*See* SLAC-PUB–6078			
0027	18:27912	*See* SLAC–417			
SLU-SKOPRO-R–					
33	18:25945	OSTI; NTIS		DE93500891	
SNV–					
4160	18:25967	OSTI; NTIS		DE93500869	
4161	18:25962	OSTI; NTIS		DE93500872	
4162	18:25968	OSTI; NTIS		DE93500877	
SOL–					
93-3	18:28191	OSTI; NTIS; GPO Dep.	E 1.99:	DE93017439	MF-405
SR/H–					
436	18:26301	*See* DPW–4358			
463	18:26302	*See* DPW–4477			
466	18:26299	*See* DPW–3660			
467	18:25637	*See* DPW–3665			
468	18:26300	*See* DPW–3668			
524	18:28088	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012364	MF-700
528	18:26313	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012422	MF-700
529	18:26285	*See* DPSP–53-368			
530	18:25905	*See* DPSP–55-454-4			
532	18:26290	*See* DPSP–54-448			
533-Del.	18:26294	*See* DPSP–55-454-1-Del.			
534-Del.	18:26295	*See* DPSP–55-454-3-Del.			
539	18:27507	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93013440	MF-702
540	18:26220	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93013441	MF-700
541	18:26314	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93013442	MF-700
542	18:27250	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93013443	MF-700
543	18:26315	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93013444	MF-700
544	18:26316	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93013445	MF-700

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
545	18:26317	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93013446	MF-700
546	18:26264	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93013447	MF-700
547	18:26318	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93013448	MF-700
551	18:26319	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93014210	MF-700
552	18:26320	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93014211	MF-700
554	18:26321	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93014213	MF-706
555	18:26322	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93014214	MF-700
556	18:26323	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93014215	MF-700
557	18:26324	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93014216	MF-700
558	18:26325	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93014217	MF-700
560	18:26326	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93014693	MF-700
561	18:26327	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93014694	MF-700
562	18:26328	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93014695	MF-700
563	18:25633	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93014696	MF-700
564	18:25634	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93014697	MF-700
565	18:25635	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93014698	MF-700
566	18:27251	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93014699	MF-700
567	18:27252	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93014700	MF-700
568	18:27253	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93014701	MF-700
573	18:25908	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93015170	MF-700
574	18:27254	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93015171	MF-700
576	18:27255	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93015173	MF-700
577	18:27256	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93015174	MF-700
578	18:26281	*See* DPES–1403			
591	18:25701	*See* DPST–74-485			
SSCL–					
601	18:27206	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016045	PC-601
607	18:27207	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013944	PC-414
614	18:27018	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016044	PC-414
SSCL-Preprint–					
149-Rev.2	18:27019	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014163	MF-414
207	18:26974	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014062	MF-414
209	18:27670	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014131	MF-414
211	18:27208	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014162	MF-414
213	18:27100	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014078	MF-414
214	18:27101	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014166	MF-414
217	18:26975	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012302	MF-400
218	18:27102	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014172	MF-414
222	18:27103	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014167	MF-414
224	18:27104	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014169	MF-414
232	18:27105	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014165	MF-414
233	18:27106	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014161	MF-414
234	18:27107	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014249	MF-414
236	18:27108	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014076	MF-400; MF-414
238	18:27020	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014138	MF-414
242	18:27109	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014254	MF-414
246	18:27110	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014132	MF-414
247	18:27111	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014170	MF-414
248	18:27112	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014311	MF-414
251	18:27113	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014168	MF-414
253	18:26976	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014079	MF-414
257	18:27114	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014074	MF-414
266	18:27115	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014176	MF-414
268	18:27116	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014175	MF-400; MF-414
271	18:27117	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014252	MF-414
275	18:27118	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014134	MF-414
278	18:27119	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014245	MF-414
281	18:27120	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014250	MF-414
284	18:27121	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014130	MF-414
285	18:27122	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014248	MF-414
288	18:27123	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014100	MF-414
289	18:27124	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016186	MF-414
293	18:27209	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014104	MF-414
300	18:27125	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014102	MF-414
308	18:27126	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014251	MF-414
312	18:27127	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014253	MF-414
328	18:27128	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016243	MF-414
329	18:27129	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014083	MF-414
337	18:27130	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016113	MF-414

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
343	18:26977	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016184	MF-414
347	18:27131	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014081	MF-414
348	18:27132	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016116	MF-414
350	18:27133	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016187	MF-414
352	18:27134	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014244	MF-414
354	18:27135	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014271	MF-414
357	18:27136	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014255	MF-414
359	18:27137	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014261	MF-414
360	18:27138	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014061	MF-400; MF-414
362	18:27139	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014272	MF-414
364	18:27140	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014181	MF-414
367	18:27021	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014264	MF-414
368	18:27022	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014262	MF-414
369	18:27023	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014069	MF-414
370	18:26978	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014178	MF-414
372	18:27024	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014067	MF-414
374	18:27141	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014060	MF-400; MF-414
380	18:27142	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014064	MF-414
381	18:27143	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014065	MF-414
383	18:27144	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014263	MF-414
391	18:27025	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016181	MF-414
398	18:27145	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016103	MF-414
399	18:27026	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016123	MF-414
400	18:27146	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016105	MF-414
409	18:27027	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016090	MF-414
411	18:27028	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016109	MF-414
412	18:27029	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016107	MF-414
414	18:27147	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015902	MF-414
428	18:26979	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016246	MF-414
97	18:27048	*See* FNAL/C–92/98			
SSDC–					
13-Rev.1	18:27657	*See* DOE–76-45/13-Rev.1			
28-Rev.1	18:26406	*See* DOE–76-45/28-Rev.1			
5-Rev.1	18:27656	*See* DOE–76-45/5-Rev.1			
SSI–					
92-02	18:27531	OSTI; NTIS; INIS		DE93630856	
92-03	18:27637	OSTI; NTIS; INIS		DE93630800	
92-04	18:27638	OSTI; NTIS; INIS		DE93631733	
92-05	18:27639	OSTI; NTIS; INIS		DE93630795	
92-09	18:27640	OSTI; NTIS; INIS		DE93630808	
92-10	18:27641	OSTI; NTIS; INIS		DE93630801	
92-11	18:28089	OSTI; NTIS; INIS		DE93631742	
92-12	18:28192	OSTI; NTIS; INIS		DE93631734	
92-14	18:28090	OSTI; NTIS; INIS		DE93631743	
92-16	18:27642	OSTI; NTIS; INIS		DE93630732	
92-17	18:27643	OSTI; NTIS; INIS		DE93630810	
92-18	18:27644	OSTI; NTIS; INIS		DE93630811	
92-19	18:26277	OSTI; NTIS; INIS		DE93630788	
92-20	18:27598	OSTI; NTIS; INIS		DE93630776	
92-21	18:26278	OSTI; NTIS; INIS		DE93630789	
93-02	18:28091	OSTI; NTIS; INIS		DE93631744	
93-03	18:28092	OSTI; NTIS; INIS		DE93631745	
93-04	18:27210	OSTI; NTIS; INIS		DE93631537	
STUDSVIK-M–					
92-93	18:26719	*See* SVF–462			
STUK-A–					
108	18:27645	OSTI; NTIS; INIS		DE93629423	
STUK-B-YTO–					
101	18:26123	OSTI; NTIS; INIS		DE93629703	
SVF–					
462	18:26719	OSTI; NTIS		DE93500702	
463	18:26820	OSTI; NTIS		DE93500706	
TEC/L–					
0471/R91	18:26157	*See* NUREG/IA–0106			
TRITA-KT–					
92-3	18:25543	*See* NUTEK-FGT–93-2			
TRITA-TEK–					
92-01	18:26720	OSTI; NTIS		DE93500842	

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
TRITA-VAT–					
3884	18:26721	OSTI; NTIS		DE93500848	
4912	18:26722	OSTI; NTIS		DE93500851	
TTC–					
1253	18:26436	*See* SAND–93-0466C			
TVA-Bull–					
Y-228	18:27369	*See* TVA/NFERC–92/6			
Y-229	18:26539	OSTI; NTIS		DE93014193	
Y-230	18:27600	*See* TVA/NFERC–92/8			
TVA-Circ.–					
Y-227	18:27599	*See* TVA/NFERC–92/5			
Z-321	18:26437	OSTI; NTIS; INIS		DE93014197	
Z-325	18:26540	OSTI; NTIS		DE93014146	
Z-329	18:27601	*See* TVA/NFERC–93/2			
TVA/NFERC–					
92/5	18:27599	OSTI; NTIS		DE93014385	
92/6	18:27369	OSTI; NTIS		DE93014192	
92/8	18:27600	OSTI; NTIS		DE93014384	
93/2	18:27601	OSTI; NTIS		DE93014386	
UCB-PTH–					
93/14	18:27757	*See* LBL–33976			
UCID–					
20622-92-2	18:26830	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014364	MF-700
UCRL–					
52000-93-3	18:26909	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013941	PC-700
UCRL-CR–					
105013	18:26910	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93009541	MF-707
107172	18:27247	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93015009	
109856	18:27370	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015010	MF-701; MF-702
110610	18:27460	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93009504	MF-702
111879	18:28024	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015007	MF-712
UCRL-ID–					
104857	18:25879	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012384	MF-714
107864	18:26911	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014829	MF-700
110984	18:26854	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014833	MF-700
111736	18:25760	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93009445	MF-702
111750	18:27211	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014370	MF-706
111954	18:28061	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014834	MF-700
112181	18:27371	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013947	MF-902
112569	18:28062	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013104	MF-712
112984	18:27372	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014677	MF-902
112994	18:26882	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014365	MF-711
113182	18:26950	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014678	MF-706
113825	18:27212	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014375	MF-706
113834	18:27222	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014682	MF-700; MF-701
113844	18:27231	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014683	MF-705
113846	18:27241	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012450	MF-700
114251	18:27232	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93015870	MF-700
114502	18:26912	OSTI; NTIS; GPO Dep.	E 1.99:	DE93017094	MF-906
UCRL-JC–					
104107	18:26855	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015116	MF-706
105283	18:27213	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015113	MF-700
107836	18:26821	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013087	MF-704
107859	18:26723	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016438	MF-705
108210	18:27461	OSTI; NTIS; GPO Dep.	E 1.99:	DE93009529	MF-703
108635	18:25761	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93009251	MF-721
108854	18:28063	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013832	MF-422
108924	18:26913	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014909	MF-704; MF-706
109143	18:26929	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013838	MF-101
109219-Rev.2	18:27223	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016426	MF-700
109276	18:25909	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012571	MF-712
109341	18:26951	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013040	MF-706
109347	18:26556	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013046	MF-700
109359-Rev.1	18:26724	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013830	MF-712
109388	18:26952	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013841	MF-904
109421	18:27214	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012606	MF-706
109651	18:26725	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013198	MF-404
109740	18:27148	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012574	MF-700

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
109851	18:28193	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012591	MF-705
109870	18:27669	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013043	MF-405; MF-402
109917	18:26726	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012588	MF-712
110007	18:26914	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015105	MF-700
110110	18:28194	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015979	MF-705
110128	18:26727	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014417	MF-704; MF-706
110198	18:27149	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013428	MF-712
110200	18:27150	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013418	MF-700
110203	18:27030	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013427	MF-712
110213	18:28064	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012599	MF-712
110265	18:26915	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014993	
110273	18:27264	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012483	MF-700
110275-Rev.1	18:26385	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012475	MF-700
110276	18:25675	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013852	MF-706
110318	18:27373	OSTI; NTIS; GPO Dep.	E 1.99:	DE93009242	MF-700
110320-Pt.2	18:25620	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012586	MF-123
110348	18:25607	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93017180	MF-903
110365	18:27374	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93010509	MF-703
110401	18:27375	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012573	MF-722
110425	18:26265	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012597	MF-706
110651	18:27810	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013835	MF-700; MF-705
110663	18:25961	OSTI; NTIS; GPO Dep.	E 1.99:	DE93009228	MF-700
110669	18:26728	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016417	MF-704
110675	18:25981	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013196	MF-123
110687	18:26729	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013842	MF-404
110706	18:26953	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014118	MF-712
110875	18:25910	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016435	MF-501
110945	18:27905	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013081	MF-700
110953	18:28025	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014419	MF-712
110983	18:25880	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012500	MF-702
111000	18:26730	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013848	MF-904
111091	18:25911	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014416	MF-500
111213	18:26954	OSTI; NTIS; GPO Dep.	E 1.99:	DE93017179	MF-706
111304	18:26731	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013834	MF-401
111397	18:26822	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014116	MF-706; MF-704
111404	18:26930	OSTI; NTIS; GPO Dep.	E 1.99:	DE93017122	MF-700
111405	18:28026	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014147	MF-705
111416	18:27376	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016534	MF-702
111448	18:27725	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015104	MF-700
111534	18:27651	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012589	MF-708
111546	18:28027	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013184	MF-712
111558-Rev.1	18:28195	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015101	MF-705
111689	18:27726	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013090	MF-700
111690	18:28065	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013414	MF-712
111717	18:27893	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014129	MF-700
111801	18:27233	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013419	MF-712
111816-Rev.1	18:28196	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015099	MF-705
111851	18:26955	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014657	MF-706
111860	18:27727	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013345	MF-700
111941	18:27215	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015103	MF-706
111951	18:27728	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016425	MF-706
111973	18:26732	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013195	MF-705
111977	18:26823	OSTI; NTIS; GPO Dep.	E 1.99:	DE93009307	MF-403
111993	18:27462	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013194	MF-703
112067	18:26733	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013421	MF-404
112103	18:27242	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012605	MF-706
112154	18:28028	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013429	MF-700
112163	18:26956	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015114	MF-712
112195	18:28197	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013084	MF-705
112217	18:26957	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015110	MF-706
112250	18:27243	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014428	
112286	18:27729	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013425	MF-700
112287	18:27906	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013424	MF-700
112302	18:28029	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013351	MF-700
112334	18:27168	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015102	MF-414
112341	18:28066	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013850	MF-712
112343	18:27151	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016547	MF-712

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
112346	18:26874	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014128	MF-700
112361	18:28067	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016454	MF-712
112367	18:27508	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014126	MF-402
112378	18:28068	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016515	MF-712
112379	18:26824	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014112	MF-712
112408	18:26825	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013422	MF-904
112521	18:26826	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016437	MF-700
112572	18:28198	OSTI; NTIS; GPO Dep.	E 1.99:	DE93017123	MF-705
112624	18:27884	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016532	MF-700
112630	18:27928	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014415	MF-706
112671	18:27224	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016529	MF-506
112689-Rev.1	18:26562	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016432	MF-421
112711	18:25762	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014430	MF-700
112981	18:26827	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014655	MF-712
113056	18:27257	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014654	MF-700
113106	18:28199	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016539	MF-905
113163	18:27929	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014418	MF-706
113268	18:25763	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016540	MF-721
113273	18:27225	OSTI; NTIS; GPO Dep.	E 1.99:	DE93017193	MF-706
113277	18:27895	OSTI; NTIS; GPO Dep.	E 1.99:	DE93017174	MF-700
113281	18:26565	OSTI; NTIS; GPO Dep.	E 1.99:	DE93017171	MF-700
113282	18:28069	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016545	MF-712
113290	18:26958	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016543	MF-706
113407	18:26959	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014656	MF-712
113498	18:27885	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014420	MF-712
113510	18:27463	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014878	MF-702
113577	18:27248	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012316	MF-721
113583	18:27377	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93017182	MF-702
113606	18:27730	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014423	MF-900
113710	18:27700	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014422	MF-712
114215	18:27152	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013856	MF-414
114505	18:28070	OSTI; NTIS; GPO Dep.	E 1.99:	DE93017155	MF-705
UCRL-LR–					
107476-Vol.1	18:25764	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014854	PC-802
UCRL-MA–					
108964-Rev.1	18:28200	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015988	MF-705
108966-Rev.1	18:28201	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015985	MF-705
108967-Rev.1	18:28202	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015970	MF-705
108975-Rev.1	18:28203	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015986	MF-705
108976-Rev.1	18:28204	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015987	MF-705
UG–					
3/93.	18:27754	*See* IC–93/81			
UNID–					
91-08	18:26159	*See* NUREG/IA–0109			
USGS-OFR–					
92-643	18:27484	*See* DOE/ID–22105			
93-187	18:27226	OSTI; NTIS; US Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225 (US); GPO Dep.	E 1.99:	DE93015498	MF-703
USGS/WRI–					
92-4184	18:27483	*See* DOE/ID/13042–8			
UWThPh–					
1992-8	18:27698	OSTI; NTIS (US Sales Only); INIS		DE93628595	
1992-60	18:27762	OSTI; NTIS (US Sales Only); INIS		DE93628912	
1992-61	18:27800	OSTI; NTIS (US Sales Only); INIS		DE93628913	
VF-H–					
92-1	18:25991	OSTI; NTIS; INIS		DE93500672	
92-5	18:25992	OSTI; NTIS; INIS		DE93500675	
92-6	18:25993	OSTI; NTIS		DE93500678	
VF-UB–					
92-46	18:25972	OSTI; NTIS		DE93500933	
93-3	18:26448	OSTI; NTIS; INIS		DE93500935	
93-9	18:25941	OSTI; NTIS		DE93500939	
93-10	18:25977	OSTI; NTIS; INIS		DE93500942	
VF-UD–					
92-49	18:26090	OSTI; NTIS		DE93500928	
VF-UH–					
93-4	18:27509	OSTI; NTIS; INIS		DE93500930	
VF-UM–					
93-5	18:27510	OSTI; NTIS; INIS		DE93500924	

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
VF-UV–					
92-36	18:25557	OSTI; NTIS; INIS		DE93500669	
VTT-PUB–					
82	18:27913	OSTI; NTIS; INIS		DE93630221	
VTT-TIED–					
1411	18:26124	OSTI; NTIS; INIS		DE93629704	
WEG–					
25-4067-REV1	18:26081	*See* ETSU-WN–5127			
33-6217	18:26063	*See* ETSU-WN–6027			
WEG-MS–					
60-405	18:26077	*See* ETSU-WN–5051			
WEG-R–					
37-6201	18:26083	*See* ETSU-WN–6046			
WHC-EP–					
0182-55	18:25765	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014633	MF-902
0182-56	18:25766	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014504	MF-902
0182-57	18:25767	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014506	MF-940
0461	18:25768	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014487	MF-902
0466-1-Rev.1	18:25769	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014623	MF-902
0474-7	18:25770	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014631	MF-900
0532	18:25771	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014489	MF-900
0569-Rev.1	18:25772	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014836	MF-902
0576	18:25773	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014503	MF-940
0621	18:25774	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014186	MF-940
0628	18:25775	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014486	MF-940
0631	18:25776	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014616	MF-940; MF-902
0635	18:25777	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014628	MF-940
0646	18:25778	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016829	MF-940
0648	18:25779	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014619	MF-940
0655-Draft	18:25780	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014140	MF-940
0658	18:25781	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014634	MF-902
0659	18:25782	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016826	MF-940
WHC-SA–					
1361	18:26734	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012613	MF-905
1420	18:26208	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014145	MF-528
1423	18:25783	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014190	MF-940
1551	18:25784	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93009430	MF-902
1608	18:25785	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93009425	MF-902
1609	18:25786	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93009431	MF-902
1623	18:25787	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014916	MF-940
1630	18:25788	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014505	MF-902
1637	18:25789	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014589	MF-940
1661	18:25790	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014626	MF-940
1671	18:25791	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014627	MF-940
1694	18:25792	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014625	MF-901; MF-902
1697	18:25793	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014488	MF-902
1701	18:25794	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014491	MF-902
1706	18:25881	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016226	MF-902
1708	18:25795	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014485	MF-940
1719	18:26916	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011284	MF-507
1729	18:25796	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016478	MF-902
1735	18:25797	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011277	MF-940
1748	18:25798	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014189	MF-902
1772	18:25676	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011275	MF-940
1781	18:28215	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014588	MF-900
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1789	18:25800	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013002	MF-940
1795	18:25801	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012616	MF-940
1810	18:25802	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011274	MF-940
1812	18:25651	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016223	MF-900
1813	18:25803	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014630	MF-700
1830	18:25804	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93008179	MF-940
1831	18:25882	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016348	MF-940; MF-902
1837	18:25805	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014490	MF-940
1839	18:25883	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012614	MF-702
1845	18:25806	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016476	MF-940
1866	18:25807	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013005	MF-940
1904	18:26541	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016477	MF-900

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1928	18:25809	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016347	MF-940; MF-902
1934	18:26329	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016479	MF-500
WHC-SP–					
0858-Rev.1	18:25810	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014635	MF-907
WINCO–					
1121	18:26567	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014825	MF-510
1122	18:25811	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93009613	PC-510
1128	18:27378	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015610	MF-600
11906	18:25848	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014874	MF-512
11907	18:26566	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014908	MF-500
11908	18:26386	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014904	MF-506
11914	18:26542	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015660	MF-502; MF-510
11916	18:25812	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015572	MF-506; MF-510
11923	18:25813	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015571	MF-502
WIS-PH–					
92-103	18:27763	OSTI; NTIS (US Sales Only); INIS		DE93629967	
WSL-CR–					
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3529(MR)	18:25577	*See* ETSU-B–1313-P3			
3560(MR)	18:25974	*See* ETSU-B–1313-P4			
3592(MR)	18:25975	*See* ETSU-B–1313-P5			
WSRC-IM–					
90-83-9	18:28205	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014740	MF-705
WSRC-MS–					
92-033	18:25814	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011786	MF-702
92-268	18:25815	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93005546	MF-701; MF-721
92-370-Rev.1	18:26387	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011778	MF-706
92-477-Rev.1	18:25884	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013580	MF-731
92-485	18:25816	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013578	MF-701; MF-704
92-503-Rev.1	18:25817	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012799	MF-721
92-518	18:26330	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013575	MF-705; MF-706
93-002-Rev.1	18:25818	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014758	MF-721
93-048	18:26388	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016175	MF-706
93-056	18:25819	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93017285	MF-700
93-167	18:26917	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011787	MF-722
93-174	18:25642	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011784	MF-700; MF-705
93-179	18:27464	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013581	MF-703
93-182	18:26331	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012758	MF-706
93-184	18:25820	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012800	MF-702; MF-708
93-201	18:27465	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013692	MF-703; MF-721
93-202	18:25821	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013827	MF-721
93-215	18:25822	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012798	MF-721
93-222	18:25823	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012754	MF-721
93-262	18:26332	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014731	MF-700; MF-704
93-287	18:26333	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013826	MF-700
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91-1148	18:26334	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014752	MF-705
92-1093	18:25826	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016126	MF-701; MF-721
92-1136	18:26391	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014755	MF-707
92-1212	18:25827	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015383	MF-701
92-1312	18:25828	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014739	MF-701
92-1392	18:25829	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011431	MF-940
92-1397	18:27466	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015379	MF-702
92-252	18:25824	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015382	MF-706
92-445	18:26389	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016136	MF-706
92-568-Rev.1	18:25825	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015831	MF-701; MF-721
92-720	18:26390	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014750	MF-706
93-459	18:27467	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014745	MF-702

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WSRC-TR–					
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91-430	18:26393	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016125	MF-706
91-499	18:26223	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014726	MF-705
91-566	18:25831	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014747	MF-700
92-029	18:26394	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016841	MF-706
92-134	18:26209	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015826	MF-706
92-335	18:26395	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014746	MF-701
92-421	18:25832	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012136	MF-701; MF-707
92-438	18:26883	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013688	MF-704
92-439	18:26336	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014751	MF-705
92-552	18:25912	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014722	MF-701; MF-704
92-96	18:26335	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014753	MF-706
93-008	18:25885	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016240	MF-706
93-0094	18:26396	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014761	MF-706
93-029	18:25833	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015890	MF-701
93-063	18:27468	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015381	MF-702
93-065	18:27469	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013574	MF-702
93-090	18:25834	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016166	MF-701; MF-721
93-102	18:25886	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016174	MF-703
93-129	18:27470	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015380	MF-702
93-215	18:27379	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014759	MF-702
93-233	18:25835	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016151	MF-702
Y/EN–					
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DE93016082	DPSP–53-1-3-Del.Ver.
DE93016087	PNL-SA–22528
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DE93016105	SSCL-Preprint–400
DE93016107	SSCL-Preprint–412
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DE93016126	WSRC-RP–92-1093
DE93016129	DOE/ER/45431–3
DE93016134	WSRC-RP–93-469
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DE93016140	EGG–10617-1242
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DE93016205	DOE/ER/60633–8
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